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PART I.

Original Contributions.

ON A CASE OF SPURIOUS NEUROMA OF THE OPTIC NERVE.

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POST-OCULAR intra-orbital tumours of the optic nerve, and of its sheath, are of such rare occurrence that the following case appears worthy of permanent record. The extremely slow rate of increase of the proptosis, indicative of correspondingly slow growth of the tumour, and the relative freedom of the movements of the eyeball, together with the normal appearances of the fundus oculi, had inclined me to regard exostosis as the most probable cause of the proptosis, and to reject as improbable a sarcoma or carcinoma of the orbital walls or optic nerve. This, however, proved erroneous.

Caroline ——, æt. 19, a thoroughly healthy-looking brunette, was admitted on 26th July, 1881, into the Middlesex Hospital with extreme proptosis of the right eyeball, to the extent that even with a strong effort she could not close the eyelids, and sometimes in the attempt they slipped behind the eyeball. This occasionally happened in the act of winking, and it was so painful to her, and the effect so distressing to those about her,

that she shunned society, and was rendered more unhappy by this than by the loss of sight.

The eyeball moved consensually with the other, and nothing unnatural could be felt within the borders of the orbit by pressure through the eyelids. Vision was reduced to quantitative perception of light. With the Ophthalmoscope nothing unnatural was discernible in the optic nerve or retina. The external aspect of the eyeball was perfectly natural.

History.—An elder sister, who accompanied her, said that the unnatural prominence of the eyeball began to be noticed in her sixth year, and that its increase had been very gradual, and unattended with pain, but with progressive loss of sight.

The patient was so anxious to be relieved of the disfigurement that she had come to London for the purpose of having the eyeball removed, should this prove necessary.

I decided to examine the back of the orbit through an incision in the conjunctiva at the inner side of the eyeball. The inner border of the orbit was chosen because I had found this more often than the other walls to be the seat of exostosis. When the finger-tip was passed in behind the eyeball it encountered in the bottom of the orbit a tumour so intimately connected with the optic nerve that it could not be separated from it. The eyeball and the tumour were therefore removed together, the optic nerve being severed close to the foramen opticum.

At the end of a fortnight the patient returned to the country wearing an artificial eye, with a corresponding improvement in her personal appearance, which was highly gratifying to her and her friends.

The tumour was firm, of a spherical outline, in size about one-third less than that of the eyeball, from which it was separated by a portion of seemingly healthy optic nerve, somewhat more than half an inch long.

The extremely slow growth of the tumour (dating its beginning from the time when the protrusion of the eyeball was first noticed) is a very remarkable circumstance, and one well calculated to lead to a mistake in diagnosis. Dr. Brailey has kindly furnished the accompanying report of its structure.

The short piece of nerve that intervenes between the eye-ball and the tumour is folded on the latter in such a way that the two bodies lie almost in apposition.

Except for some thickening, the dural sheath passes unchanged over the mass, but the loosely-arranged fibres of the intervaginal space are enormously increased in the neighbourhood of the entrance of the nerve into its front part. They also bear far more nuclei than normal. Towards the centre of the tumour they gradually become replaced by an imperfectly fibrillated tissue containing numerous cell elements, of which the majority are small, perhaps ·005 mm. in diameter, and only slightly elongated, with dot-like nuclei. From them all gradations of size are found up to the largest, which are ·026 mm. in diameter, oblong, and perhaps slightly drawn out at the ends, with several dot-like nuclei and numerous granules. The pial sheath and nerve-fibres lose themselves in approaching the centre of the tumour. The new growth appears to be a sarcoma, taking its rise in the loose tissue of the intervaginal space, most probably from the nucleated cells found upon its fibres.

ON A CASE OF SARCOMA SPRINGING FROM THE SHEATH OF THE OPTIC NERVE—EXCISION OF THE GLOBE AND REMOVAL OF THE TUMOUR—RECURRENCE—DEATH—NECROPSY—SECONDARY DEPOSITS.

By George Lawson, F.R.C.S.,

Surgeon to the Royal London Ophthalmic Hospital, and Surgeon to the Middlesex Hospital.

Tumours of the optic nerve are comparatively rare. They may occur in two ways—1. They may be external to the nerve-fibres, and spring from the dural sheath of the nerve. 2. They may grow from within the nerve, being intimately associated with the connective-tissue between the nerve-fibres, and constituting a neuroma. The following case is an example of a sarcoma springing from the dural sheath of the optic nerve. In the next number of the Reports I will give the case of a large neuroma of the optic nerve, which projected the eye completely beyond the orbit.

Samuel S., æt. 65, was admitted into the Royal London Ophthalmic Hospital on the 26th October, 1880, suffering from all the symptoms of an orbital tumour behind the left eye. The eyeball was bulged considerably forwards and a little outwards, and was immovable. The cornea was clear; there was a good anterior chamber, the pupil dilated and inactive; no perception of light. The eyelids were swollen and closed on the protruding eye; and the conjunctiva was also swollen and chemosed.

History.—The patient was unable to give any satisfactory account of the progress of the case. He was apparently very indifferent and apathetic, and had not really detected that anything was wrong with the eye until it began to protrude.

He stated that he first noticed a hardness around the eye about five weeks before his admission into the Hospital, and that this rapidly increased and caused the eye to bulge.

On November 11, 1880, having first excised the globe, I

then removed a solid tumour which occupied the orbit, and completely surrounded the optic nerve.

Dr. Brailey, the Curator of the Museum, made a section of the globe, and a microscopical examination of the tumour.

The parts within the eye were normal, except the optic disc, which was greatly swollen from the pressure of the tumour in the orbit.

The growth was a round-celled sarcoma, and appeared to spring from the sheath of the optic nerve. The drawings show a section of the tumour, and also the manner in which the neoplasic elements had infiltrated themselves amongst the fat vesicles of the orbit.

Fig. 1.

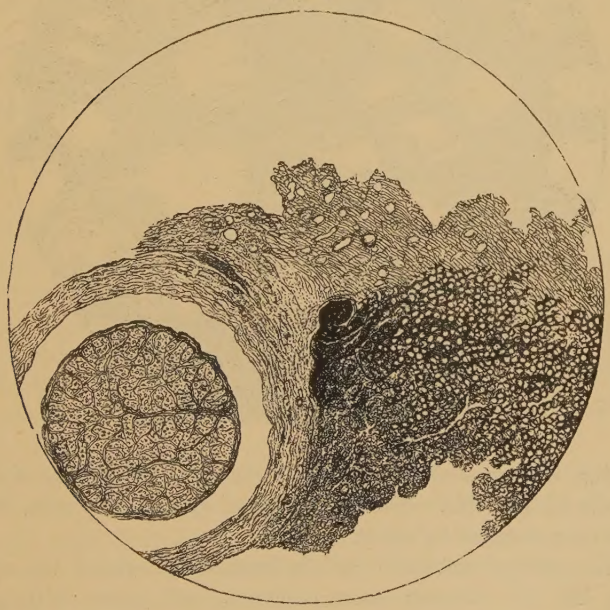

Fig. 1 shows a section of the sarcomatous tumour connected with the exterior layers of the dural sheath of the optic nerve, and apparently originating from it. Its elements are small round cells (diam. 7μ); their great bulk is constituted by a nucleus, surrounding which is a very narrow unstained zone. Between

the cells there is a scanty faintly fibrillated intercellular substance. These cells are found lying in rows or clusters between the fibres constituting the outermost part of the dural sheath.

External to the limit of the sheath the cells are closely arranged. Still more distally from the nerve the cells are found infiltrating the fat of the orbit.

Fig. 2.

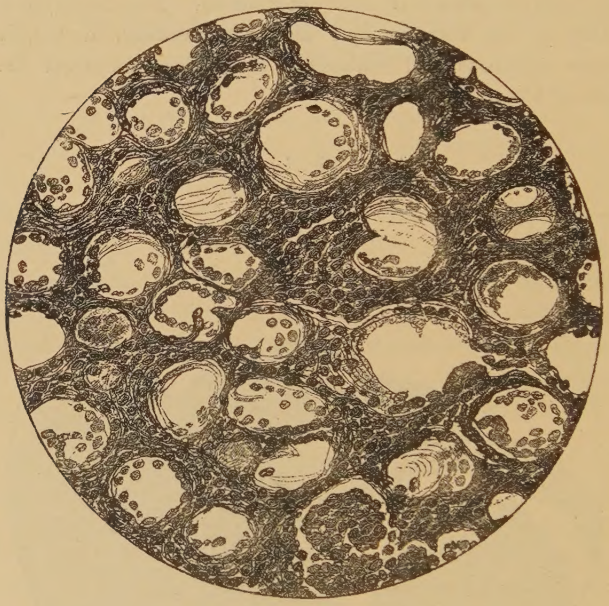

Fig. 2 represents the tumour-elements infiltrating the fat vesicles of the orbit. The white spaces are the fat cells, which have been emptied by ether.

The patient recovered rapidly from the effects of the operation, but the tumour soon recurred, and grew with great rapidity.

On January 12th, 1881, the patient was admitted into the Handel Ward of the Middlesex Hospital.

There was then a solid tumour occupying the orbit and protruding as a large fungoid mass from between the eyelids, which were red and swollen. From the ulcerated surface of the tumour

there was a bloody fœtid discharge. The parotid, submaxillary, and a chain of glands in the left side of the neck were very large, hard, and nodulated.

The man stated that he detected the recurrence about a month after the operation, and that the tumour had grown rapidly.

He was extremely emaciated, and suffered at times much pain in the side of the head. The fungating tumour was dressed with antiseptic lotions, and opium was given in such repeated doses as required, to allay pain and produce sleep.

Gradually the patient became weaker, and on February 16th, 1881, he died.

The following is the report of the *post-mortem* examination:—

General Appearance.—Body emaciated; a large fungoid growth protrudes from between the left eyelids. The whole of the left side of the neck and supra-clavicular fossa were filled with nodular masses and diffused secondary growths. The right side of the neck had also some prominent nodules beneath the skin.

Abdomen.—The intestines were moderately distended. The mesenteric glands uniformly enlarged and mostly of the size of small beans. On section these glands were white and glistening. A large mass of secondary growths was found around the duodenum and pancreas.

Thorax.—The left pleura was adherent everywhere. There were also a few adhesions at the apex of the right pleura. There was no fluid in the pleural cavities.

Heart, 10 oz.—The pericardium contained a few drachms of clear serum. The right auricle and ventricle contained a large clot and some fluid blood. The left ventricle contained fluid blood and a small ante-mortem clot. The valves were normal and patent. The aorta was slightly atheromatous.

The Right Lung, 27 oz., was large and emphysematous; the bronchi were filled with frothy mucus, and the mucous membrane was injected. The upper lobe was slightly congested; the middle and lower lobes were deeply congested and œdematous. The bronchial glands were enlarged and filled with secondary sarcomatous growth.

The Left Lung, 14 oz., was congested throughout, but slightly crepitant and very œdematous.

Right Kidney, 6½ oz.; *Left Kidney*, 6¾ oz.—Both kidneys were filled with secondary sarcomatous nodules, hard and white on section; these were distributed equally through the cortex and medulla.

Supra Renals.—The supra renal bodies were normal.

Liver.—Surrounding the portal vein there was a large mass of secondary deposit in the form of rounded tumours. On section they were soft and white, and in the centre there were generally some fine hæmorrhages. In the substance of the liver there were a number of secondary deposits of a similar kind, one the size of a Tangerine orange being situated in the left lobe just beneath the diaphragm.

Spleen, 6 oz.—A few small nodules were found in the cortical tissue of the spleen. The organ was congested.

Brain.—On removing the skull cap the anterior two-thirds of the surface of the left hemisphere was found to be covered with a thick layer of greenish coagulated lymph. The vessels of the pia mater were minutely injected all over the left hemisphere. On the right side the injection was much less marked. On removing the brain and exposing the orbital plates of the frontal and sphenoid bones, they were found to be very thin, and almost perforated towards the posterior part of the orbit. On lifting up the orbital plates the right or inner wall of the left orbit was found to be deficient; its place was occupied by a soft pulpy mass, which extended into the substance of the ethmoid and sphenoid bones. This was an extension of the growth from the orbit.

Frontal Lobes.—The under surface of the apex of the left frontal lobe was soft and of a reddish-brown tint; this softening extended for some little distance into the substance of the frontal lobes. Just outside the softened patch there was a small hæmorrhage into the pia mater, and similar small extravasations were found on the under surface of the cerebellum and pons Varolii.

Optic Nerve.—A section of the optic nerves showed that the left was of a perceptibly greater diameter than the right.

Left Orbit.—The orbit contained a soft mass of recurrent growth, which nearly filled its cavity.

ON A CASE OF HYDATID TUMOUR OF ORBIT—PROTRUSION OF EYE—SUPPURATION OF HYDATID CYST—REMOVAL—RECOVERY.

By George Lawson, F.R.C.S.,

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In the "Clinical Transactions" of 1876, vol. ix, p. 134, I recorded the case of a patient from whom I removed a large hydatid tumour of the orbit, and gave the report of Dr. Cobbold's examination of the cyst. The case which I have now to relate is another instance of that remarkable affection. The patient was sent to me by Mr. Wilcox, of Aylesbury, who had seen her once or twice previous to her coming to the Hospital.

History of Case.—Seven or eight years ago the patient had diplopia, which continued for some time, and only disappeared when the sight of the eye became so defective that it ceased to take cognisance of surrounding objects. Soon after this the eye became slightly prominent. This protrusion of the globe gradually progressed, and with occasional attacks of pain in the orbit. Three weeks before admission the prominence of the eye having greatly increased, Mr. Wilcox punctured the tumour, and some clear colourless fluid escaped. After that there was great pain in and about the tumour, associated with redness and swelling of the lids. The patient was admitted into Moorfields on December 30th, 1881.

State on Admission.—There was great proptosis of the right eye, the globe being bulged about three-quarters of an inch from the head. There was swelling and chemosis of the conjunctiva of the lids and globe. The lower eyelid was red, and from the swollen state of the conjunctiva completely everted. The sight of that eye was reduced to a mere perception of large objects. A free incision was made into the tumour through the everted oculo-palpebral fold of conjunctiva of the lower lid, when a

quantity of pus escaped. The finger was then introduced into the wound, and a thick hydatid cyst, about the size of a pigeon egg, was turned out. The walls of the cyst were laminated, of a yellowish-white colour, and of a leathery consistence.

The patient progressed satisfactorily, the globe receded to its normal position, and the patient left the hospital on January 4th, 1882, with the wound almost healed.

ON A CASE OF LARGE ORBITAL AND INTRACRANIAL IVORY EXOSTOSIS—REMOVAL OF ORBITAL PORTION—DEATH THIRTY-TWO DAYS AFTER OPERATION—NECROPSY.

By John Tweedy, F.R.C.S.,

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Two reasons may be assigned for the publication of the following notes: first, cases of ivory exostosis of the orbit are comparatively rare; second, this particular instance was seen by a large number of visitors to the Moorfields Ophthalmic Hospital during the meeting of the International Medical Congress. Those who witnessed the operation will remember its difficulties, and may wish to know its result. The patient speedily rallied from the immediate effects of the operation, and progressed so satisfactorily for a month, that all anxiety seemed to be at an end. Thirty-one days after the operation he suddenly manifested symptoms of cerebral meningitis and died in a few hours. While I regret the fatal termination, I cannot conceal the fact that from the pathological standpoint, and, indirectly, from the clinical, the post-mortem examination furnishes lessons of greater value and importance than those afforded by the living case.

Herbert B., aged 25 years, an excavator, was admitted on July 26, 1881. It was stated that the left eyeball had been prominent for two years, and that the protrusion was steadily increasing. There was, however, no pain either in the eyeball itself or in the parts around.

On examination shortly after admission, the left globe was found to be pushed forwards, downwards, and outwards, by a growth of bony hardness occupying the upper and inner part of the orbit from the mid-orbital ridge to the situation of the lacrimal sac. The movements of the globe were not much

restricted, and the vision was normal $\left(V = \frac{20}{20}\right)$, notwithstanding the presence of well marked optic neuritis, characterised by great œdema of the papilla and enlargement and tortuosity of the veins.

The sight of the right eye was also normal.

After consultation with my colleagues, Messrs. Lawson and Couper, who confirmed the diagnosis of a bony tumour, I resolved to make an exploratory incision, and remove the growth if desirable. This I accordingly did on August 2.

The patient having been put under the influence of ether, I made an incision an inch and a half long through the skin and the orbicular muscle, along the superciliary ridge, and opposite the base of the tumour. The growth was found to be semiglobular in shape and of uniform hardness. It filled the upper and inner part of the orbit in front, and extended backwards as far as the finger could reach. After a brief consultation, in which I had the benefit of the personal experience of Dr. H. Knapp, of New York, I set to work to remove as much of the growth as I could. The periosteum was incised close to the orbital margin, and then stripped off the tumour from before backwards by means of a raspatory. Several ineffectual attempts were made to penetrate the base of the growth, first with a gouge, and afterwards with highly tempered steel chisels and a mallet, but the bone was so hard that no impression could be made on it; the edges of the chisels were soon spoiled. I then had recourse to a drill worked by a powerful Archimedean screw. By means of drills of various sizes I managed to bore a large number of tunnels in various directions through the base of the growth, parallel with the upper and inner walls of the orbit. I then cut through the narrow bony septa, between the borings, with a stout carpenter's chisel. When the chisel had made its way deep enough to act as a wedge, I gave a few energetic blows with the mallet, and succeeded in breaking off the whole of the orbital portion of the growth. When this was accomplished the orbital cavity seemed almost normal in size and shape, though it was obvious that a large mass forming the base of the growth still remained behind. As the operation had lasted nearly two hours, it was deemed unadvisable to prolong it in order to get away the remainder of the growth. The cavity was syringed out with a

warm solution of carbolic acid (1—20), and a caoutchouc drainage tube was inserted. The lips of the wound were then brought together by means of silver wire sutures, and a moist carbolised compress was applied. The patient was carried to bed before he recovered from the anæsthetic.

The piece of bone removed was as large as half a good-sized walnut, and was so dense that fragments of steel from the broken chisels and gouge were firmly imbedded in the surface of section, which was as smooth and bright as polished ivory.

No constitutional reaction followed the severe and prolonged operative procedure. The pulse and temperature did not transcend the normal limits. Sleep was tranquil, and the appetite continued unimpaired.

Next morning, with the exception of some listlessness, the patient's manner seemed unchanged. Then, as on succeeding days, the wound was kept thoroughly drained by means of the rubber-tube, and was syringed out twice a-day with a solution of carbolic acid (1—40). A carbolised compress was, in addition, kept constantly applied over the lips of the wound.

A week after the operation the man got out of bed, and seemed to be in perfect health. The discharge from the wound gradually diminished, and the inflammatory swelling steadily subsided.

Three weeks after the operation there was scarcely any discharge from the wound, and no pain or discomfort. Though the swelling opposite the inner angle of the orbit had grown less, it was noticed that the protrusion and displacement of the globe remained unaltered. The movements were, however, freer than before the operation.

The progress of the case continued to all appearance satisfactory, and altogether devoid of anxiety and trouble, till the morning of September 2, or exactly one calendar month from the day of operation.

On September 1st the man had been exercising as usual in the ward and in the out-buildings of the Hospital, seemingly in perfect health and strength. At 8 P.M. he complained of slight pain at the top of his head. This he himself ascribed to cold. He had a disturbed night, and at 10.30 next morning his temperature suddenly rose to 102° F., and the

pulse went up to 80. The skin was dry, the tongue was clean, and the bowels were free.

I saw the case at mid-day, and found a little increase of swelling about the wound, and thinking that pus might be pent up, I opened up the wound gently with a large probe. I failed to discover any great collection of pus, though a small quantity of dirty-looking shreddy fluid followed the withdrawal of the probe. The wound was gently syringed with the carbolic lotion and the compresses were renewed.

At 9 P.M. there was sudden exacerbation of the headache with occasional rigors. The temperature was 103° F., pulse 60, but very irregular. Ice was applied to the head. Shortly afterwards unconsciousness supervened, and at 11 P.M. profound coma set in, with stertorous breathing, and occasional slight convulsive attacks, equal on both sides. There was no hemiplegia or paralysis of the facial or ocular muscles. The pupils were not dilated, but were equal, and acted to light. At midnight the pulse was 120, full and bounding, and the respiration was laboured. Half-an-hour later the man died. There was no convulsion for about an hour before death.

Necropsy, September 3, fifteen hours after death.

Body muscular and well nourished. Above the inner canthus of the left eye was a circular opening which had been occupied by drainage tube, and which led down to bare bone, where tumour had been chiselled off. On removing the calvaria it was found that the greater part of the exostosis was in the left anterior cranial fossa. It had originally sprung from within the left frontal sinus, and had grown chiefly upwards. The roof of the sinus was in part extended over the tumour, and in part absorbed by it. In the frontal sinus were a few semi-transparent polypoid growths. The bony growth reached one inch above the orbital plate of the frontal bone, and extended for that distance into the left anterior lobe of the brain. It measured two inches from before backwards. It also sent a prolongation about half-an-inch long downwards into left side of the nasal cavity, and this portion was broken off the remainder of tumour, apparently at the time of the operation. Backwards, the growth had forced its way into the inner end of the great sphenoidal fissure. The cut surface of the growth had numerous bits of steel embedded in it. The growth was

capable of being slightly moved. There was no marked increase of subarachnoid fluid. There was general basilar meningitis, with a little lymph in the fissure of Sylvius and at the anterior part of the pons Varolii.

The brain in immediate contact with the tumour was in a state of red softening, being semi-fluid, with some puro-lymph on its surface at the summit of the bony mass. The left olfactory bulb was involved in this focus of softening and degeneration. The left optic nerve was stretched across a groove in the growth at the posterior part. The tumour with the adjacent superciliary ridge was removed, and the brain as well as the backs of both eyes and the optic nerves and chiasma were preserved for further examination.

The portion which had been removed by operation was claimed by relatives, who interred it with the body.

The microscopical examination of the optic nerve disclosed the presence of a certain amount of inflammatory cells in the intervaginal space, but without much distension. In the nerve itself were two tracts of inflammation in the midst of otherwise normal tissue (*see* Fig. 3). One of these extended from near the central vessels towards the pial sheath, though without distinct relations to either; the other was smaller, and situated on the opposite side of the central vessels midway between them and the sheath. In these inflammatory areas a few hypertrophied trabeculæ were to be seen, and the nerve-tissue was crowded and obscured by great numbers of nuclei.

Remarks.—The practical lesson taught by this case is that it is impossible by the orbital portion alone to judge of the real size and extent of an exostosis springing from the frontal sinus; and, consequently, that other indications must be sought for in considering the feasibility of removing the tumour by operative interference. Though the operation performed in this case may not have shortened life, it would be idle to pretend that it prolonged life.

Should another case of exostosis ever come under my care, I shall endeavour to ascertain the size of the growth and its probable extent within the cranium before deciding to complete the operation.

The difficulty of making any impression on an ivory exostosis with a chisel, saw, or trephine, is so great that several cases have been recorded in which the operation had been abandoned. Keate tried to remove one of these growths with a trephine, but had to desist on account of the hardness, and Sir A. Cooper attempted in vain to saw an ivory exostosis from the edge of orbit.*

Mackenzie† relates that in the year 1843 he witnessed a case similar to those of Keate and Cooper. A gouge, cutting pliers, rasp, and paring-knife were tried on the surface of the exostosis without effect. A chain-saw was then applied, but would not work. Finally, with a Hey's saw a small portion of the growth was subsequently removed, with great difficulty. Ten years later, the exostosis remained exposed in the wound, and bore the marks of the saw "as if the operation had been done but yesterday."

It may interest some to know the sequel of this case. It is given in manuscript in one of the interleaves of the late Dr. Mackenzie's private copy of his work, which is in my possession by the favour of my esteemed friend and teacher, Mr. Wharton Jones, F.R.S.

The rough notes in Dr. Mackenzie's handwriting run thus :—" 26th May, 1858. Five years since last report, patient was admitted into Eye Infirmary; exostosis much more protruded, much more movable, and pus copiously discharged from behind it. Without much trouble it came away. It is much necrosed, and of a very irregular form. The orbit felt entire after its removal, but evidently much displaced downwards, along with the eyeball, which was twisted outwards. The upper lid much shrunk and misshapen. No vision in eye. Cavity filled with lint. Cornea not so opake, I think, as it was. Long diameter of piece $1\frac{7}{8}$ inch. weighed 4 drams 2 scruples and 7 grains. The exostosis seems to have been developed between the inner and outer

* Quoted by Mackenzie, A Practical Treatise of the Diseases of the Eye, 4th ed., Lond., 1854, p. 47.

† *Ibid.*, p. 48.

table of os frontis, leaving a large cavern communicating with the right frontal sinus. The roof of orbit, or rather its lower table, is depressed, along with eyeball. The floor of orbit is half-an-inch below its proper level. Is now free from pain and expresses great relief by removal of exostosis. Piece of carious bone felt near frontal sinus. Parts granulating and healthy. Upper lid much shrunk and displaced."

Other cases have been recorded where the operation had to be given up. Dr. Knapp had to abandon the operation in one case. Seven weeks after the operation, the first five having been passed quietly and favourably, the patient was attacked with symptoms of meningitis of which she died.* Since that case Dr. Knapp has succeeded in removing the tumour on at least two occasions. In the last case an ivory exostosis as large as an English walnut was removed entirely by a process of "subperiosteal enucleation."† The osseous surroundings and connexions of the tumour were cut through with a narrow chisel and the mass shelled out from its periosteal coverings.

As I have already stated I had, during my operation, the benefit of Dr. Knapp's presence and counsel. I was, however, afraid to adopt the plan recommended by Dr. Knapp in so large a growth. The sequel of the case justified my fears. It would have been impossible to have removed the whole of the tumour by the subperiosteal method. Even after death, with the calvaria removed, it was only possible to withdraw the whole of the growth by sawing through the superciliary portion of the frontal bone. Nevertheless, in a demonstrably small exostosis, I readily admit that Dr. Knapp's method offers the best prospect of safe and effectual removal.

* Graefe's Arch. f. Ophth., viii, 1, p. 239, *et seq.*, and quoted by S. Wells, A Treatise on Diseases of the Eye, 3rd. ed, London, 1873, p. 722.

† Archives of Ophthalmology, vol. ix, pt. 4, New York, 1880, pp. 464—470.

EXPLANATION OF THE FIGURES IN THE PLATE.

Figs. 1 and 2 show the actual size and relative positions and appearance of the growth on its outer and its inner aspects respectively. (The drawings have been inadvertently reversed by the engraver, and seem to represent right side instead of the left).

In Fig. 1 the atrophied shell of the orbital plate is seen forced upwards by the projecting growth. The optic nerve originally lay deeply imbedded in the groove immediately behind the horizontal portion of the orbital plate. The roughened surface below this process, and looking to the right of the figure, represents the surface from which the orbital portion of the exostosis was detached at the operation.

In Fig. 2 a smooth piece of the orbital plate or part of the ethmoidal bone is seen attached to the tumour about the centre. The part above this level was intracranial, and the smooth oval piece to the lower part, and the left side of the figure, lay within the nasal cavity.

Fig. 3 is a representation of the microscopical appearance of a section of the optic nerve. For a description see p. 307.

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Fig. 2.

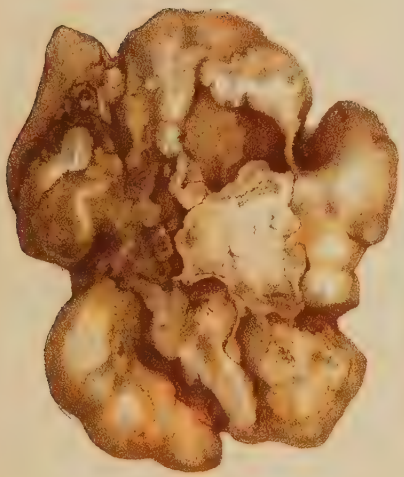

Fig. 1.

Fig. 3.

F Huth, Lith^r Edin^r

ON A CASE OF TUMOUR OF THE BRAIN—OPTIC NEURITIS—DEATH—NECROPSY.

By Geo. Lawson, F.R.C.S.,

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The following case was under the care of Surgeon-Major Perry of the Coldstream Guards, and was seen by Sir William Gull, Dr. Hughlings-Jackson, and myself. From the general symptoms and the well marked optic neuritis of one eye, a tumour of the brain was thought probable. The diagnosis was verified by the post-mortem examination which was made by Dr. Greenfield:—

The patient was first seen by Mr. Perry early one morning in August, 1878, and to him I am indebted for the following notes:—He had then had a severe epileptic convulsion, but had recovered from it, and was sitting up in bed and able to answer questions. Within an hour the convulsions recurred. They were very violent; each convulsion lasted a few minutes, and was followed by an interval of coma, and the convulsions recurred about every twenty minutes. These recurrences continued for about seven hours, when the convulsions ceased, and the patient drifted into deep coma. This state of coma lasted for about three hours. The patient then became restless, and later on delirious and violent. He would frequently try to speak, but could not articulate words. After about twenty-four hours from the first convulsion he fell asleep, and on waking he had recovered consciousness. For the next few days he was kept very quiet, and with the exception that he complained of feeling stiff and bruised, and that his expression was dull and heavy, he seemed pretty well. Previous to this attack the patient had for some time slept badly, and was irritable. He was a man of the most abstemious habits.

In the September following he was sufficiently recovered to be able to be removed to the country, and he was ordered to take bromide of potassium, which he continued for about three

months. He steadily improved in health, and travelled about the country visiting various friends. The patient had no return of the convulsions, but on two occasions between September and the beginning of December, he had two attacks of most violent headache. He described the pain as being almost unbearable.

On January 29th, 1879, he was seen by Sir W. Gull and Dr. Hughlings-Jackson, who diagnosed a tumour of the brain. The patient seemed to get steadily worse; he became weak, and a little unsteady in his gait. He was unable to fix his attention or to read for long.

In April, 1879, I saw the patient. The distant vision of both eyes was normal, but he had considerable loss of accommodative power. His memory he said was defective, and his walk was distinctly unsteady. With the ophthalmoscope there was seen well marked optic neuritis in the right eye; the disc was blurred and swollen, and the veins very large. My diagnosis concurred with that already given.

His unfavourable symptoms continued steadily to increase. He became more feeble, complained of defect of sight, and towards the end of May his memory was markedly deficient.

On June 3, Dr. Perry states in his notes the patient is very feeble; the sight worse; and he complains of headache.

June 9. Patient very drowsy and difficult to rouse. He remained all day in a condition of semi-coma.

June 14. Is able to speak a few words with difficulty; no headache; has some difficulty in swallowing.

June 19. Condition much the same; talks clearly. Is under the impression that he is by the sea away from home. Pulse 67; temperature normal. The temperature has been taken daily. Occasionally it has been one degree above normal.

June 26. Is not so well; sight very defective; mind confused; his bowels and bladder act involuntarily. Thinks he is in the country.

July 4. General weakness increasing, and is losing flesh rapidly. Appetite good. Sleeps well without the bromide of potassium. Fancies that he is constantly travelling.

July 14. Not so well. At 3.30 P.M. found him almost insensible. Right side of face paralysed. Right pupil dilated and insensible to light. Left pupil contracted. When spoken

to loudly will put out his tongue slowly, and will not withdraw it until again spoken to sharply.

July 15. Spoke a few words in the morning. This afternoon he is in a state of coma, breathing stertorously. Pulse 70. Temperature normal. Pupils the same.

July 16. Has recovered from the state of coma. He thinks that he is abroad. His mind always wandering to places at which he had resided when in health.

July 18. The patient was able to be carried into the garden to-day. Passes his stools involuntarily.

July 30. Has been in a state of semi-coma for fifty-four hours. Pupils continue the same.

July 31. Gradually recovering consciousness.

August 2. Has again become unconscious.

August 3. Is slightly better, and spoke a little, but could not recognise his friends. There is much rigidity of the muscles of the arms. Pulse 62. Temperature 98.

August 6. Has had a quiet night. Spoke at times, and seemed sensible, but did not know where he was.

August 10. Has again relapsed into insensibility, and cannot be roused to speak. Is able to take small quantities of liquid food. The left arm and leg quite rigid, and from time to time there are slight convulsive movements of the left leg.

August 16. Quite insensible. Pulse 40. Extremely weak. Towards evening he rallied. Pulse 58. Temperature 96·6.

August 22. More sensible. Pulse 58. Temperature 97·4. Contraction of flexors of right arm, and slight contraction of flexors of right thigh and leg.

August 24. Passed a very restless night. Face flushed. Temperature 101. Pulse 112. Profuse perspiration. Pupils the same. In the afternoon convulsive movements of the left leg, and with the neck arched back. This condition lasted one hour, during which time his face was much distorted. Pulse rose to 140. From this condition he again passed into coma, in which he continued until he died on August 31.

Report of the Post-mortem Examination made Twenty-four Hours after death by Dr. Greenfield.

Only the head was examined. Bones of skull natural.

Dura mater externally appeared somewhat too vascular, the veins also full of blood. Longitudinal sinus full, but quite natural. Pacchionian bodies well marked.

Before removal of the dura mater it was observed that there was greater prominence over the anterior half of the right hemisphere than the left, and an area in the same region where the dura mater was somewhat more opaque than natural, but beyond this nothing abnormal. On attempting to separate the membrane it was found to be firmly adherent to the upper surface of the right hemisphere over a circular area $1\frac{1}{4}$ inches in diameter, near the middle line, and commencing about 1 inch from the tip of the hemisphere. Over the adjacent portion of the hemisphere the dura mater was very slightly adherent to the surface of the brain by a thin layer of sticky exudation; and there were traces of slight recent meningitis (rosy colour of pia mater, dull appearance of arachnoid, turbid fluid in meshes of pia), extending backwards nearly to the occipital region.

Over the left hemisphere dura mater separated readily; no sign of meningitis.

The anterior third of the right hemisphere was to a large extent occupied by a tumour of somewhat ovoid shape, which measured $2\frac{1}{4}$ inches in length, 2 inches in width, and $1\frac{1}{3}$ from above downwards. It weighed nearly 4 ozs. Where it reached the surface it involved the posterior two-thirds of the 1st frontal convolution and a small part of the middle of the 2nd frontal; it was limited posteriorly by the anterior margin of the ascending frontal convolution. Towards the inner (median) aspect of the hemisphere it did not come to the surface, though separated from it by a very thin shell (not more than $\frac{1}{8}$th inch thick) of brain substance.

Below, it encroached upon the anterior part of the right lateral ventricle. No excess of fluid in ventricles. Marked softening of the brain substance surrounding the tumour, especially below and to the outer side.

The tumour itself was remarkably dense and firm, very sharply defined, and readily separated from the surrounding brain tissue, though firmly adherent to the dura mater above. Its surface, smooth, rounded, slightly lobulated, highly vascular, covered by a ramified network of small vessels, from which vessels passed into the surrounding brain tissue. On section it

The diagram represents only the part of the tumour which came to the surface, the darker shaded portion being the area adherent to the dura mater. It is only approximately accurate.

was of somewhat dark fleshy-red colour, rather paler towards the centre; highly vascular; homogeneous and not encapsuled; slightly granular in appearance, but apparently made up of interlacing bands of tissue; very firm to the touch.

The remainder of the substance of the brain appeared in every respect healthy; the centra ovalia pale.

Vessels and nerves at base perfectly healthy, with the exception of left optic nerve, which appeared somewhat flattened, as if wasted.

Cerebellum, pons, medulla oblongata, and upper part of cord appeared perfectly healthy.

W. S. Greenfield, M.D., F.R.C.P.

September 2, 1879.

ON EIGHT CASES OF CONICAL CORNEA, TREATED BY ELLIPTICAL EXCISION OF APEX.

By C. Higgens, F.R.C.S.,

Assistant Ophthalmic Surgeon to Guy's Hospital.

The following eight cases of conical cornea have all been treated by the operation which I first saw performed by Mr. Bader, viz., by the removal from the apex of the cone of a small more or less elliptical portion, comprising the whole thickness of the cornea.

The operation is performed by transfixion with a thin Graefe's knife, formation of a small flap, which is picked up with iris forceps and removed with a stroke of the knife in a direction opposite to that in which the flap was made. The anterior chamber is opened pretty freely, but the opening into it is not so large as the wound on the anterior surface of the cornea, the incisions passing obliquely through its structure from within outwards.

The after-treatment consists in keeping both eyes carefully bandaged for a longer or shorter period, according to circumstances. The dressing (wet lint) is changed daily, but neither eye is opened for at least a week.

Iridectomy is performed later if anterior synechia sufficient to close, or nearly close, the pupil occur. The opacity if unsightly is tinted.

Whether the results of my cases compare favourably with those obtained by other methods of treatment I do not know. They are as follows:—

Case 1. Recovered with anterior synechia, but with greatly improved vision. Before the operation the eye could not see well enough to count fingers. Eight months after V $= \frac{20}{50}$, and Snellen $1\frac{1}{2}$ (·5) could be read by the aid of + 12″.

Case 2. Had an anterior synechia, which afterwards separated spontaneously. Vision improved from ability to read Snellen 12 (= 4) by the aid of a small circular opening, to $\frac{20}{200}$, and Snellen $3\frac{1}{2}$ (1·25) at 6 inches without assistance.

Case 3. Went entirely to the bad.

Case 4. Vision was improved from counting fingers to Snellen ·5 at 4 inches, $\frac{6}{36}$ by the aid of −10 D. The pupil was circular and active.

Case 5. Recovered with dense corneal opacity and anterior synechia, requiring iridectomy and tinting. Snellen 1·5 could be read at 6 inches.

Case 6. Vision was greatly improved, but the patient left the hospital before it was accurately tested. The pupil was circular.

Case 7. Recovered with circular movable pupil. Vision was improved as much as could be expected, seeing the condition of the deeper parts of the eye.

Case 8. It was necessary to repeat the operation. On the first occasion a portion of cornea was removed from the side of the cone with but little effect. An anterior synechia resulted, which became detached spontaneously after the second operation. The pupil was circular and movable, vision improved from perception of shadows only to Jaeg. 4 at 2 inches, a result as good as could be expected, seeing the condition of the vitreous.

Case 1. Thursa O., a servant maid, first came under observation at the Central London Ophthalmic Hospital in March, 1872.

The sight of the right eye had been failing five years, but had grown rapidly worse in the last six months. The left eye had been failing two years.

The right eye could distinguish large objects, but could not count fingers.

The left eye read Snellen $2\frac{1}{2}$ at 4 inches.

On April 2, a small portion, including the whole thickness of the cornea, was removed from the apex of the cone in the right eye.

No bad symptom occurred. On the 8th of May there was considerable corneal opacity with anterior synechia.

$V = \frac{20}{50}$.

On November 30, nearly eight months after the operation, vision of right eye $= \frac{20}{50}\ c + 12''$, $\frac{20}{50}$; read Snellen $1\frac{1}{2}\ c + 12''$.

The left eye had grown no worse.

Case 2. Sarah G., æt. 30, a lady's maid, came under treatment at Guy's Hospital December 7, 1876.

Believed that she had been getting near sighted for some considerable time. Ten months before date had accidentally covered the left eye, and found that she could not see with the right. No lenses improved sight, but $V = \frac{20}{50}$ with small circular opening, without it large objects could be seen indistinctly. Left eye $V = \frac{20}{200}\ c - 6''\ \frac{20}{50}$.

Nine months later right eye could make out Sn. 12 at 4 inches when using stenopeic plate.

The left eye by the same means read Sn. $3\frac{1}{2}$ at 6 inches.

November 27, 1876. A small elliptical piece of cornea, including its whole thickness, removed from the apex of the cone in right eye.

The wound healed firmly. On January 1, 1877, there was an opacity of the cornea, rather above and to the outer side of the pupil, the margin of which was adherent to it.

A month later, the anterior synechia had given way from action of the iris unaided by atropine; the pupil was circular and freely movable; the corneal opacity remained about the same.

Right eye, $V = \frac{20}{200}$. No improvement with lenses. Read Sn. $3\frac{1}{2}$ at 6 inches easily.

Left eye, $V = \frac{20}{70}$ not improved by lenses, but rather better with stenopeic plate Sn. $2\frac{1}{2}$ at 10 inches.

Case 3. Lizzie M., æt. 22, no occupation, has done a great deal of fine sewing and much reading; first came under treatment in January, 1879. She had been a little near sighted as long as she could remember, but during the last five years she had noticed that she was getting rapidly worse. The right eye failed faster than the left, and at the end of three years was nearly blind; the left could still distinguish a person across a fair sized room, and could see to read a newspaper with difficulty at about 6 inches. During the last two years the sight of both eyes had remained about the same.

The right eye could make out Sn. $4\,c - \frac{1}{12}$ at 8 inches. With horizontal stenopeic slit Sn. 3 at 16 inches, through small circular opening Sn. 2·25 could be read at 8 inches, and $V = \frac{6}{36}$.

The left eye could read S. 1·25 at 5 inches without aid, with small circular opening $V = \frac{6}{24}$.

On January 13 a small elliptical piece, including the whole thickness of the cornea, was removed from the apex of the cone.

Ten days later the eyelids were red and swollen, and the cornea was found to be infiltrated with pus.

The central portion of the cornea disappeared, and was replaced by iris and cicatricial tissue, a ring of clear cornea remaining.

Subsequently iridectomy was performed downwards and outwards. The pupil became blocked by inflammatory material. The eye retained perception of light.

Case 4. Lucy R., æt. 18, came under treatment in December, 1879. Right eye could not count fingers; with stenopeic plate could read a letter here and there of Sn. 4. Left eye could read Sn. 4 at 4 inches without aid, Sn. 6 at 4 inches with stenopeic, and $V = \frac{6}{36}\,c - 5{\cdot}50\,\mathrm{D}$.

December 15, 1879. Portion of cornea, including its whole thickness, removed from apex of cone.

A fortnight later the wound was firmly healed, and the pupil circular and active.

On February 1, 1880, six weeks after the operation, a small

linear opacity of the cornea rather above the centre of the pupil, remained. The eye could read Sn. 1·5 at 4 inches without aid, and $V = \frac{6}{36} c - 10$ D.

Case 5. Joseph J., æt. 21, draper's assistant, came to Guy's Hospital February 19, 1880. No history was taken. There was divergent strabismus of the right eye with well marked conical cornea; the eye could barely count fingers at a few inches. Readjustment was performed.

Four days later the conical cornea was treated by removal of a portion of the apex of the cone, including the whole thickness of the cornea. Recovery was slow, but eventually took place, a dense corneal opacity with shallow anterior chamber and anterior synechia remaining.

Five months later the opacity was tinted and iridectomy performed.

A month after, the eye could read Snellen 1·5 at 6 inches.

Case 6. Hildric F., æt. 28, a clergyman, first came August 2, 1880. Left eye well marked conical cornea, some opacity at apex of cone, sight gradually failing; two years could count fingers at a foot.

Right eye failing eighteen months. Could read Sn. 5 at 6 inches. $V = \frac{6}{12}$.

August 9, 1880. A small portion, including whole thickness of cornea, removed from apex of cone.

August 23. Anterior chamber re-established, but still some leakage; pupil circular. No anterior synechia; vision not tested. The patient was anxious to go away, and was not seen afterwards, but wrote some weeks later to say that the eye had quite recovered, and he could see fairly well with it.

Case 7. Annie S., æt. 37, admitted January 17, 1881. Twelve years ago first noticed gradually increasing dimness of sight in the left eye. Lately the right eye has begun to fail, which she attributes to over use.

The left eye sees shadows. There is well marked conical cornea. The right eye $V = \frac{6}{9}$ barely; no improvement with + or -- sph. or cyl. The apex of the cone was removed, as in the other cases.

March 21. Wound soundly healed; no synechia; cone rather large; central opacity. Counts fingers at 3 feet.

September 27. Left cornea slightly conical, central opacity; makes out a letter here and there of Jaeg. 20 at 10″. Pupil circular, movable. There is a large posterior staphyloma. Patient now states she never could see with the left eye.

Case 8. Phillis H., æt. 42, admitted February 21, 1881. Twenty years ago discovered that the sight of the right eye was very defective; she has been unable to read with it since first discovering the defect; does not think there has been much change for many years.

The centre of the cornea is occupied by a very pointed cone, the apex of which is opaque; there is some floating opacity in the vitreous. The eye has perception of shadows only. The left eye has begun to fail in the last few years; the cornea is slightly conical; there is some floating opacity in the vitreous; the eye reads Jaeg. 6 at 6 inches.

A portion of elliptical shape, including the whole thickness of the cornea, was removed from the side of the cone in the right eye.

March 14. Wound soundly healed; small anterior synechia; counts fingers, and can tell one from the other.

April 11. Vision not improved since last report; cone still very prominent; large elliptical piece removed from its apex.

July 4. Reads Jaeg. 4 at 2 inches; the synechia which resulted from the first operation has separated, and the pupil is circular; vision is not improved by lenses.

ON A CASE OF SYMPATHETIC OPHTHALMIA.

By Anderson Critchett, M.A. (Cantab.),

Ophthalmic Surgeon to St. Mary's Hospital.

As the subject of sympathetic ophthalmia is now exciting considerable interest, especially with reference to the incubation period of the disease, and to the relative immunity which can be obtained by removal of the injured eye, the following case may serve to throw some light upon these debatable points:—

J. P., a gamekeeper, æt. 30, was struck in the right eye by a stray shot on November 3, 1881, which penetrated the coats of the eye in the ciliary region. He was taken on the same day to a provincial hospital, where he remained for a fortnight under palliative treatment. On November 17th he was admitted under my care at St. Mary's Hospital. The injured eye was found to have received a small circular wound as described above, and it was evident that an escape of vitreous had occurred, causing the tension of the globe to be minus. The pupil was irregular, a portion of the iris being drawn up and involved in the wound. On ophthalmoscopic examination, only a faint reflex could be obtained. The patient did not complain of pain, and there was but slight evidence of inflammatory action. The appearance of the left eye was in all respects healthy, and the vision, which was accurately tested, was found to be normal; whilst the ophthalmoscope revealed no trace of optic neuritis. On the following day the right eye was enucleated. On examination, the track of the shot could be accurately traced, from its entry at the ciliary region, by the presence of a thin line of blood-clot extending through the vitreous to within a short distance of the corresponding point on the opposite side of the globe, where the shot itself was found, having impinged upon, but not penetrated the retina.

The patient was discharged on November 23, his left eye being re-tested, and found to be in all respects as healthy as

it was on his admission. He was cautioned to use the eye sparingly, and to avoid strong light for some weeks to come. On December 3, *i.e.*, fifteen days after the operation, and exactly a month from the date of the accident, he first noticed that distant objects appeared to be slightly misty and indistinct. His limit of vision lessened daily for about a week, when he could only distinguish large objects at a distance of a few yards. The eye then became red and painful, the condition both as regards vision and inflammation varying somewhat from day to day till the end of March, when the more active symptoms subsided, but the sight remained so far impaired that shadows only could be distinguished. The gravity of these symptoms was not sufficiently appreciated by the patient, who attributed them to an accidental cold; and, as he was at a considerable distance from London, he did not again seek my aid till the 15th of May, when he was re-admitted to St. Mary's Hospital.

In the left eye well-marked signs of sympathetic ophthalmia had set in, though modified in some degree by the rapidity with which it had occurred. The pupil was completely occluded, and the iris was slightly thickened and bulging, though it had evidently not undergone the complete structural metamorphosis which often occurs in strongly-marked cases of this type. The anterior chamber was extremely shallow, and the tension of the globe was + 2. For the relief of this latter symptom, and in the hope of restoring free communication between the anterior and posterior chamber, an iridectomy was performed on May 16th. By making slow and gentle traction on the iris, I was fortunately able to detach it from its adhesion to the anterior capsule and to remove a portion corresponding to the size of my incision in the corneo-sclerotic junction, leaving a clear black aperture. On May 20th the patient was able to count fingers at the distance of 12 inches. At the present date (June 2nd), he can distinguish faces, the tension is normal, the artificial pupil remains clear, and the anterior chamber has almost resumed its natural proportions.

It is worthy of note, that the presence of a foreign body

within the eye considerably increases, as in this instance, the gravity of the case. The isolated instances of gun-shot injury which have come before my notice, where the injured eye has not been removed, probably owed their immunity from subsequent trouble in great measure to the facts that the shot did not wound the ciliary region, and that it went with sufficient force to traverse the globe and lodge in the surrounding tissues.

Until a comparatively recent period, a strong and apparently well-grounded impression prevailed amongst ophthalmologists that when the injured globe was removed, before any evidence of irritation could be noticed in the other eye, complete freedom from sympathetic ophthalmia might be confidently predicted. This comfortable doctrine recently received a rude shock at the hands of Mr. Nettleship, who has conclusively shown that painful exceptions to this rule occasionally occur; and the case which I have quoted above strongly tends to confirm that view. The practical inference which may be drawn from this and similar cases is, that grave danger can result from even a short delay, and that an emphatic decision should, if possible, be at once arrived at as to the necessity which exists for removal of the injured organ, since it is evident from the present case that this peculiar form of sympathetic inflammation must have made an insidious commencement within fifteen days from the date of the accident.

ON SYMPATHETIC OPHTHALMITIS FOLLOWING EXTRACTION OF CATARACT.

By W. J. Milles, F.R.C.S.,

Senior House Surgeon, Royal London Ophthalmic Hospital.

Sympathetic Inflammation, resulting from the extraction of a senile cataract, is happily such a rare disaster that it scarcely suggests itself, when considering the risks of the operation. It has fallen to my lot, as House Surgeon, to have had under observation the unusually large number of eleven cases of undoubted sympathetic inflammation due to the above cause. One of my reasons for giving an account of these cases is that often more may be learned from the disasters than from the successes of surgery.

I have reduced my notes to as small a compass as is consistent with a description of the important points; a minute account of each individual case at the various stages of the disease would have involved an unnecessary repetition.

All the patients were fairly good subjects for operation; the cataracts were not complicated by any other disease of the eyes; the pupils were active, projection good, tension normal.

Case I.—*Extraction of Cataract. Puncture and Counter-puncture in Sclerotic. Prolapse of Iris. Sympathetic Ophthalmitis in three months.*

Mary W., æt. 52, gave a history of failure of the right eye for seven years. She had a mature cataract in this eye, with active pupil, normal projection, and normal tension. Left, immature cataract.

September 25, 1881. *Right.* Modified Graefe extraction, puncture, and counter-puncture in sclerotic, the latter rather far back. The iris was torn at the outer part during the operation. Patient was discharged in three weeks' time without having had any pain.

Readmitted March 3, 1881, with a history of pain in right eye since her discharge from the hospital, and slight uneasiness in the left for the last week.

In the right (exciting eye), there was keratitis punctata, a flattened prolapse of iris, and a firm opaque capsule, and some posterior synechiæ. V = J. 19 c + 16 d. T.—.

In the left (sympathising eye), keratitis punctata was more marked, iritis with a large quantity of lymph in the pupil.

V = counts fingers at 8″. T.n.

During the two following months she was under observation, the right eye quieted down, though the keratitis punctata never completely disappeared; the iris became discoloured and drawn backwards in its lower half. The globe was tender at times. T. — always. Vision remained the same.

In the left eye the quantity of lymph gradually increased, till a thick layer covered the anterior capsule of the lens; large masses projected forwards from the iris, cornea was covered with dots, anterior chamber deep. T.n.; V = hand reflex. Pain was at times very severe, especially in the left eye.

Case II.—*Extraction of immature Cataract. Sympathetic Ophthalmitis in eight months. Iridotomy in Exciting Eye, resulting in Normal Vision. Sclerotomy in Sympathising Eye.*

Sarah H., æt. 63.

Left counts fingers at 8″; cataract nearly mature.

Right. J. 10 c + 4 d.; cataract immature.

May 10, 1880. *Left.* Modified Graefe extraction; a small quantity of soft matter left behind.

Patient discharged at the end of three weeks, with an opaque capsule, and still some soft matter in pupil.

Readmitted January 31, 1881. Right had been getting dim, with some pain during the last fortnight.

Left.—Anterior synechiæ of iris and capsule to wound, deep anterior chamber; triangular mass, irregular and punctiform at its edges, on posterior surface of cornea. T. +.

Right.—Serous iritis with keratitis punctata. T. +.

In the right (sympathising eye) the pupil dilated slowly, but contracted again through the increase of the lymph deposit. The eye became glaucomatous and very painful, and in August,

1881, sclerotomy was performed; but the wound bulged, and though the pain ceased and all active inflammatory symptoms disappeared, perception of light was completely lost.

In the left (exciting eye) the iritis and mass of lymph had completely gone at the end of two months. An iridotomy was performed on March 17, 1881, with some loss of vitreous, and in the following August the vision was as follows:—

c + 12 D $\frac{20}{20}$ c + 16 D., J. 1 at 8″.

I saw this patient only a short time back, and found that the sight in this eye was still the same.

Case III.—*Extraction of Cataract. Suppurative Irido-Cyclitis. Sympathetic Ophthalmitis in three months.*

Thomas C., æt. 56.

January 27, 1881. *Right.* Modified Graefe's extraction, section wholly corneal, operation uncomplicated. On the third day the wound was infiltrated, anterior chamber soon became filled with puro-lymph, and suppurative irido-cyclitis followed. At the end of two months the eye was quiet, but partially shrunken, T. −1; perception of light. Three months after the operation patient was readmitted with sympathetic iritis in the left eye.

The right (exciting eye) was much in the same condition as at the time of his discharge from the hospital a month ago. The corneal section was depressed, cornea was small, globe slightly shrunken, and not tender on pressure; the iris was drawn up and atrophied. Bare perception of light. T.−1.

In the left (sympathising eye) the posterior synechia yielded to atropine, but soon the iritis became more severe. Keratitis punctata appeared at the end of four months, and masses of lymph filled up the pupillary space. At the end of six months there was a deposit of lymph, covering the lower half of the cornea, and the iris was barely visible, owing to the muddy condition of the aqueous. T. + 1. Sees shadows.

Case IV.—*Preliminary Iridectomy. Extraction of Cataract. Sympathetic Ophthalmitis in six weeks. Vision in Exciting Eye good for some months, gradually failed.*

Jane B., æt. 63.

May 31, 1881. *Right.* Modified Graefe extraction, a preliminary iridectomy having been performed six weeks previously. (The notes of the operation have been mislaid.)

Readmitted July 8, 1881. Patient had experienced some pain in the left eye for the last month.

Right (exciting eye). Fine membrane in pupillary space, section corneal, some posterior synechiæ. $V = \frac{20}{50}$ c + 10·5 d., J. 6, c + 15·5 d.

The vision remained as above for two months, when the capsule contracted, vision becoming only $\frac{20}{200}$. The capsule was needled, but the opening closed again.

It was thought advisable not to perform any further operation on this eye till the sympathising eye had quieted down. In six months' time, owing to drawing up of the pupil, V = counting fingers at twelve inches.

In the sympathising eye (left), almost exactly the same changes occurred as in the last case, serous iritis, keratitis punctata; finally a large deposit of lymph. At one stage a number of vesicles appeared on the anterior surface of the cornea. Tension variable from T.n. to T. + 1.

Case V.—*Extraction of Cataract. Suppurative Irido-Cyclitis. Shrinking of Globe. Sympathetic Ophthalmitis in seven weeks.*

Thomas R., æt. 57.

June 1, 1881. *Right.* Modified Graefe extraction; the operation was uncomplicated. The sequence of events is almost identical with Case III. Suppuration commenced at the corneal wound, suppurative cyclitis followed, and the globe shrank. On being readmitted four months later, the patient stated that the right eye had remained painful since he left the hospital, and that the left had become irritable and painful seven weeks after the operation.

The right (exciting eye) was found to be shrunken, with a puckered corneal scar, painful and tender. No perception of light.

The left (sympathising eye) had shallow ant. chamber; numerous posterior synechiæ, which would not yield to atropine;

large vessels in iris, keratitis punctata, &c. Two months later the whole cornea was covered with dots, the pupil was occluded by lymph, T + 1, and V = shadows.

CASE VI.—*Extraction of Cataract. Entanglement of Iris in corner of Wound. Sympathetic Ophthalmitis in nine weeks. Good Vision in Exciting Eye.*

William T., æt. 72.

June 28, 1881. *Left.* Modified Graefe extraction. The cataract was mature, but the pupil was sluggish previous to the operation. When the patient was discharged at the end of three weeks, an entanglement of iris was noticed at each corner of the wound.

On readmission four months after, he was suffering from sympathetic ophthalmitis, the first symptoms of which had appeared nine weeks after the extraction. The exciting eye had been perfectly quiet.

Left (exciting eye) section corneal, small entanglement of iris in each corner of wound; pupil active; no ciliary injection. V c + 11 d = $\frac{20}{70}$. The eye remained in the same condition, and two months later V c + 11 d = $\frac{20}{50}$, c + 15 d. J. 10.

Right (sympathising eye) underwent the usual changes of serous iritis; dots on cornea; variable tension. Vision finally shadows.

It is remarkable that no reactive changes whatever occurred in the exciting eye, the only apparent cause of the sympathetic ophthalmitis being a small entanglement of iris.

CASE VII.—*Extraction of Cataract. Suppurative Irido-Cyclitis. Sympathetic Ophthalmitis in eight weeks. Excision of Exciting Eye.*

There is great similarity here to Cases III and V.

Elizabeth T., æt. 68. The sight in the left eye had been failing for twenty-five years. There was a history of pain in the eye for the last four months, but the notes state that she had active pupil; field of V. good, and saw shadows. The right had an immature cataract.

September 30, 1881. *Left:* modified Graefe extraction, some soft matter being left behind. A very slow painless form of suppurative irido-cyclitis ensued, which ultimately cleared up, leaving a partially shrunken globe, and bare perception of light.

Patient readmitted two months later, with history of pain in right eye eight weeks after the operation.

Left (exciting eye) was considerably shrunken and tender; the corneal scar was puckered; bare perception of light. T.—1. It was enucleated.

Right (sympathising eye) had numerous posterior synechiæ, which yielded to atropine, but soon reformed; dots were noticed six weeks later. At first there was great pain, but it soon ceased. Patient was under observation for five months. Tension had been variable, often T.+1, cornea finally covered with dots; shallow anterior chamber, pupil contracted and occluded by lymph. V = shadows. Pain considerable at times.

Case VIII.—*Extraction of Cataract. Suppurative Iritis and Entanglement of Iris. Sympathetic Ophthalmitis in six weeks.*

Hannah S., æt. 73.

27th May, 1881. *Left.* Modified Graefe extraction. Operation uncomplicated, followed by iritis, and at the end of three weeks by hypopyon, which very slowly disappeared.

On readmission in two months' time, she stated that she had had some pain in right eye six weeks after the operation.

Left (exciting eye). There was a small entanglement of iris at inner corner of the section, with adhesion of capsule to middle of it. The pupil was drawn up. T.—. V = shadows.

Right (sympathising eye). Serous iritis. Keratitis punctata. T.+1. V = shadows.

This patient was under observation for several months, during which period she was subject to attacks of great pain in the sympathising eye, the tension of which was often high. The exciting eye finally had no perception. T — 1; globe slightly tender. In sympathising eye pupil gradually closed; ant. ch. became shallow; iris swollen, with vessels visible on its surface. V = shadows. T. + 1.

CASE IX.—*Extraction of Cataract. Counter-puncture in Sclerotic. Sympathetic Ophthalmitis in three months. Iridotomy in Exciting Eye.*

H. B., æt. 73.

March 9, 1880. *Left.* Modified Graefe extraction elsewhere. Patient says she could see well after the operation. Three months later the sight in both eyes failed rapidly, the right becoming very painful, and remaining so up to the time of her admission into Moorfields Hospital, on September 19, 1881. Her condition was as follows:—

Left (exciting eye). The operation scar reached far into the sclerotic on the inner side; pupil was drawn up and closed by a dense membrane; good perception of light. T.n.

Right (sympathising eye). Cornea dull, especially in its lower half and posterior surface; anterior chamber very shallow; pupil occluded; iris sodden and bombé. No perception. T. + 3.

An iridotomy was performed on the left eye; iris was found to be tough, and did not gape satisfactorily. Six weeks later the operation was repeated, and a good permanent opening was obtained. At the end of three months the patient was able to read J. 20 c + 15 d, with exciting eye.

The sympathising eye was painless, but still glaucomatous. No perception of light.

CASE X.—*Extraction of Cataract by Scoop. Closed Pupil. Iridotomy. Sympathetic Ophthalmitis in fifteen months.*

N. C., æt. 61.

April 13, 1880. *Left.* Modified Graefe extraction; lens did not present, and was removed by the scoop, with loss of a small quantity of vitreous. Iritis followed; the pupil became closed and drawn up.

Four months later an iridotomy was performed with a broad needle; a clear central pupil resulted, which, however, closed again in a short time.

After an interval of nearly a year the patient came to the hospital on account of pain in the right eye during the last three weeks.

The right eye was suffering from well marked sympathetic

ophthalmitis. The cornea was dull, and covered with dots aqueous muddy; iris greatly swollen. T.n.

The patient had attacks of pain in this eye during the next few months. T. + 2 at times; keratitis punctata remained constantly present.

Left (exciting eye) was not painful or tender. Pupil was drawn up and occluded. Another iridotomy was attempted, but was followed by great reaction, and at the end of a fortnight the opening had completely closed.

The tension of exciting eye became minus, with bare perception of light.

CASE XI.—*Extraction of Cataract. Iritis and Closed Pupil. Sympathetic Ophthalmitis in eight weeks, without Pain.*

George P., æt. 76.

December 24, 1881. *Right.* Modified Graefe extraction, followed by a slow painless form of iritis, with lymph filling up the pupil.

Patient was readmitted in three months. He had only noticed slight uneasiness in the left eye, commencing eight weeks after the operation.

Right (exciting eye). The pupil was drawn up and occluded by a very dense membrane; no incarceration of iris. The capsule was adherent to the wound; dots over the whole cornea, and aqueous muddy. T.n.

Left (sympathising eye). Cornea steamy; iritis; adhesions slowly yielding to atropine. T.n. Dots noticed in a fortnight.

During two months he had no pain in the eyes. In the exciting eye the keratitis punctata resulted in a large plaque; there was very little injection, and no tenderness. T.n. V = shadows. In the sympathising eye the pupil was kept fairly dilated with atropine, aqueous became very muddy; dots increased; anterior capsule of lens was covered by exudation. T.n. V = shadows.

In all cases the treatment (of the sympathetic ophthalmitis) consisted in confining the patient to a dark room, usually with a black bandage over the eyes; in dilating the pupil as long as possible with atropine; and in alleviating

pain by leeches, blisters, and morphia. A course of mercury was tried in a few instances, but with no apparent influence on the progress of the disease.

Perhaps the best method of making a useful comparison of the salient points of these cases, will be to place their leading characteristics under a few important headings.

Sex and Age.—The patients were five men and six women, their ages ranging between 52 and 76, the average age being 65.

Operation.—Graefe's modified linear extraction was performed in each case. The extremities of the section were within the cornea, except in Case 1, where puncture and counter-puncture were in the sclerotic, and in Case 9, where counter-puncture was far back in the sclerotic.

Accidents during the Extraction.—In six cases the operation of extraction was uncomplicated. In two some soft lens matter was left behind. In one the iris was partially torn from its attachment. In one the cataract had to be removed by the scoop, with slight loss of vitreous. In one the notes of the operation have been lost.

Results from Extraction.—As regards the condition of the exciting eye after the operation, in two instances there was simply a small incarceration of iris in the corners of the corneal section though with good vision. In one a dense membrane and posterior synechiæ formed as a result of iritis; in two iris and capsule were adherent to the wound; in two more the pupil was drawn up and closed by membrane; in one suppurative iritis of a painless character resulted; and in three instances suppurative irido-cyclitis occurred, and was followed by shrinking of the globe.

The interval between the extraction and the onset of sympathetic ophthalmitis was, as a rule, two to three months. The shortest period was six weeks, the longest 15 months.

Frequency of Keratitis Punctata.—I was especially careful in watching for this symptom, as I have been struck with the fact that it almost invariably occurs in sympathising eyes. Sometimes it may require a very minute examination to detect the dots; in one case I was able to see them with a

Coddington lens some days before they were visible to the naked eye.

Dr. Brailey from his researches on the pathology of sympathetic ophthalmitis is of opinion that there is always some histological evidence that the disease begins as uveitis serosa, with keratitis punctata, however well marked the uveitis maligna may be at the later stages. From a clinical point of view these cases tend to confirm his statement.

I find from my notes that keratitis punctata was invariably observed in the sympathising eye, usually at an early period. Case 9 is an apparent exception; but it is to be noticed that this patient was not seen till 15 months after the commencement of the disease, and that distinct traces of the keratitis punctata were left in the form of an opacity on the posterior surface of the cornea.

The dots certainly occur at an early stage of the disease; they remain not for weeks, but for months (*see* Cases 2, 4 and 8), and have a tendency constantly to increase in numbers, till they often coalesce into a large plaque; this plaque may ultimately be absorbed, leaving only a few traces behind.

It is interesting to note that in three instances dots were present in both eyes (Cases 1, 2, and 11); they always occurred in the exciting eye first. It shows that occasionally some of the pathological changes that occur in the sympathising eye may be present in the exciting eye.

Variable Tension.—In the sympathising eyes the tension varied from time to time; one day it would be normal, another day increased. This variation in the degree of tension is, I believe, one of the characteristics of sympathetic inflammation. I find that in Case 2 only was the tension normal throughout, and it is noticeable that this patient never had any pain or tenderness in the eyes.

Results as regards Vision.—It is an interesting and remarkable circumstance that several of these patients retained excellent vision in the exciting eye.

In Case 2, thirteen months after the sympathetic ophthal-

mitis had commenced, the patient was able to read with the exciting eye $\frac{20}{20}$ and J. 1, with correcting glasses.

A parallel case to this is described by Dr. D. Webster.*

Case 6 is nearly as good. He was able to read $\frac{20}{50}$ and J. 10 with the exciting eye five months after the commencement of the sympathetic disease.

In Case 4 the patient's vision in the exciting eye (after three months) was $\frac{20}{50}$ and J. 6 with glasses. The opening in the capsule, however, slowly closed, and vision diminished. Two other patients after eight months and twenty months respectively, were able to read J. 19 and J. 20 with the exciting eye.

The severity of the sympathetic ophthalmitis bore no proportion to the damage done to the exciting eye.

What the final result may be to the sympathising eye it is difficult at present to say. Though some of the patients have returned to the hospital after an interval of several months, active changes were still going on. Under these conditions, of course, any operative interference would have been worse than useless. In one case a sclerotomy was performed on a very painful glaucomatous eye; it was successful in so far that the pain was relieved, though the result to the eye was not satisfactory.

I wish, in conclusion, to acknowledge the courtesy of the various members of the surgical staff in placing the above cases at my disposal.

* Trans. Amer. Ophth. Society, vol. iii, part i.

ON A CASE OF EMBOLISM OF THE CENTRAL ARTERY OF THE RETINA, MODIFIED BY THE PRESENCE OF A CILIO-RETINAL ARTERY.

By Arthur H. Benson, M.B., F.R.C.S.I.,

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Since 1859, when von Graefe made his memorable observation with the ophthalmoscope, which for the first time explained the true cause of a series of cases of sudden blindness, which had before that been amongst the hidden mysteries of disease, embolism of the central artery of the retina has attracted the attention of all ophthalmologists. A vast number of cases has since been placed on record showing much variety in the degree and position of the obstruction, but with symptoms and ophthalmoscopic appearances so uniform and unique that the diagnosis can now in most cases be made without difficulty.

It would, therefore, seem unnecessary for me to add to this record any additional description, nor would I venture to do so, but that one of my cases presents some peculiarly interesting points which make it differ from any others which I have myself seen, or of which I can find any record.

Since reading Mr. Nettleship's remarks on the occurrence of cilio-retinal blood-vessels (vol. ix, part II, p. 161, of these Reports, 1877), I have been on the watch for cases to test the accuracy of his "general statements," Nos. 9 and 10, where he says, "The presence and size of this communicating vessel does not appear to bear any relation to disease;" and again, "no practical significance can at present be attached to this peculiarity in the blood supply of the yellow-spot region of the retina."

It seemed an obvious supposition that if these vessels ran

the course which he described, in the event of an embolus lodging in the trunk of the central artery of the retina, the vessel deriving its blood from the ciliary arteries might still continue to supply that portion of the retina to which it was distributed, and save it from sharing in the general destruction attendant upon a total occlusion of the efferent artery.

Since then I have seen eight cases of embolism of the central artery of the retina, in all of which the peculiar ophthalmoscopic appearances were present, but in none of them was there any indication of the presence of a cilio-retinal vessel, except in the last, the notes of which I here give, and from which I took the accompanying ophthalmoscopic drawings.

M. F., a young lady, aged 16 years, was brought to me on 26th April, 1882. She stated that three days previously whilst quietly at her devotions she observed her left eye become suddenly stone blind. After a few hours the sight somewhat improved, so that she could make out the position of large objects. When I saw her she could see my hand moving, but could not count fingers at any distance. The pupil was slightly dilated and sluggish. The tension was normal. She had experienced no premonitory auras.

The ophthalmoscope showed a considerable area of the retina to be in a condition of ischæmia. The region of the macula was marked by the characteristic cherry-red spot, situated in an area of pale greyish-white œdematous retina. The disc was hazy as to its margins, and was surrounded by an area of œdematous retina on all sides except that towards the macula, in which direction it was normal in appearance.

The œdema, which was very intense immediately round the macula, terminated abruptly by a wavy line slightly to the nasal side of the yellow spot, the line of demarcation diminishing in precision as it curved round to touch the disc above and below, leaving an oval area of perfectly healthy-looking retina existing between the yellow spot and the disc.

The œdema elsewhere faded off into the non-œdematous peripheral retina. The vessels of the retina were not much altered from the normal; the arteries were rather smaller, and

the veins rather larger than the normal, but no empty or thread-like vessels could be observed.

The flow of blood through the veins seemed rather stagnant, and in the large superior temporal branch where it bent over the artery, a distinct difference in the flow could be observed, the blood moving in a visibly incomplete stream suggesting the idea of a waterfall. Pulsation in most of the vessels could easily be produced by pressure. Some of the vessels were seen with accentuated distinctness over the grey œdema, whilst others again were hidden by the opaque nerve fibres.

A *cilio-retinal* vessel was observed springing from the outer side of the disc, and running towards the yellow spot through the region of healthy-looking retina.

To that vessel, no doubt, was due the fact of that portion of the retina being free from œdema.

Fatty degeneration of the retina seemed to have already commenced, and some brightly refracting specks were visible especially at the nasal side of the disc, where the œdema was not intense. One small hæmorrhage was to be seen in the œdematous retina above the macula.

The field of vision was very much restricted.

A careful examination of the heart failed to detect any evidence of disease, nor was there any history of rheumatic fever or other constitutional taint. She had suffered from infantile paralysis, and was still lame on the right leg, but in all other respects she was in excellent health.

Treatment.—It seemed pretty certain that whatever had been the seat of obstruction, the circulation was, when I first saw the case, for the most part re-established, though not in its entirety, for the arteries were still small, and the tension of the blood in the veins decidedly low.

Judging by former experience, and by the recommendations of all writers with whom I was acquainted, I anticipated no return of useful vision; for though Dr. Wood-White and Dr. Eales had lately recorded cases in which vision had been recovered, yet in this case so long a time had elapsed since the accident with so little improvement, that I was prepared for the worst result. However, the circulation having been pretty well re-established, it occurred to me that the indication was to keep up the nutrition of the retina until such time as the œdema

would be absorbed. The continuous electrical current had been attended with such benefit in the hands of Mr. Gunn ("Roy. Lond. Ophth. Hosp. Reports," vol. x, part 2, p. 161) in cases of atrophy of the optic nerve, that it seemed reasonable to expect its influence on such a case as this, where atrophy was sure to supervene, would be beneficial in retarding its onset, and limiting its degree. I therefore applied the current from six cells of Leclanché's battery for five minutes, reversing the poles before terminating. I also employed palpation in the hope that the clot might thereby be dislodged, but after the latter observed no change in the appearance of the vessels.

Next day vision was improved to $\frac{6}{36}$. The continuous current was again used as before.

On the following day, April 28, V = $\frac{6}{24}$, electricity again used. The perimeter chart taken showed the field of vision to be limited to a circle of less than 10 degrees radius round the fixation point.

On 29th V = $\frac{6}{18}$, there was some increase in the appearances of fatty degeneration of the retina, but the œdema was but slowly diminishing. Electricity again.

30th, same as on previous day.

May 1st (9th day), the first drawing and chart were taken; the œdema had somewhat subsided, and the sharp outline of its border near the macula was less exact. The periphery of the retina showed more stippling.

May 7 (15th day), atrophy was rapidly coming on, the disc was white, and the vessels much reduced in size. The field of vision had improved, especially at the outer side, where it now reached out to the 20 degree circle. V = $\frac{6}{12}$ and Jäg. 1, slowly. The battery had been used daily.

June 1st (the second drawing and chart were made). The battery had been used daily since last observation. The disc was perfectly white with well-defined edges. The vessels of both veins and arteries were very much reduced in size, but pulsation could be produced by pressure on the globe.

The region of the macula was marked by a peculiar goblet-

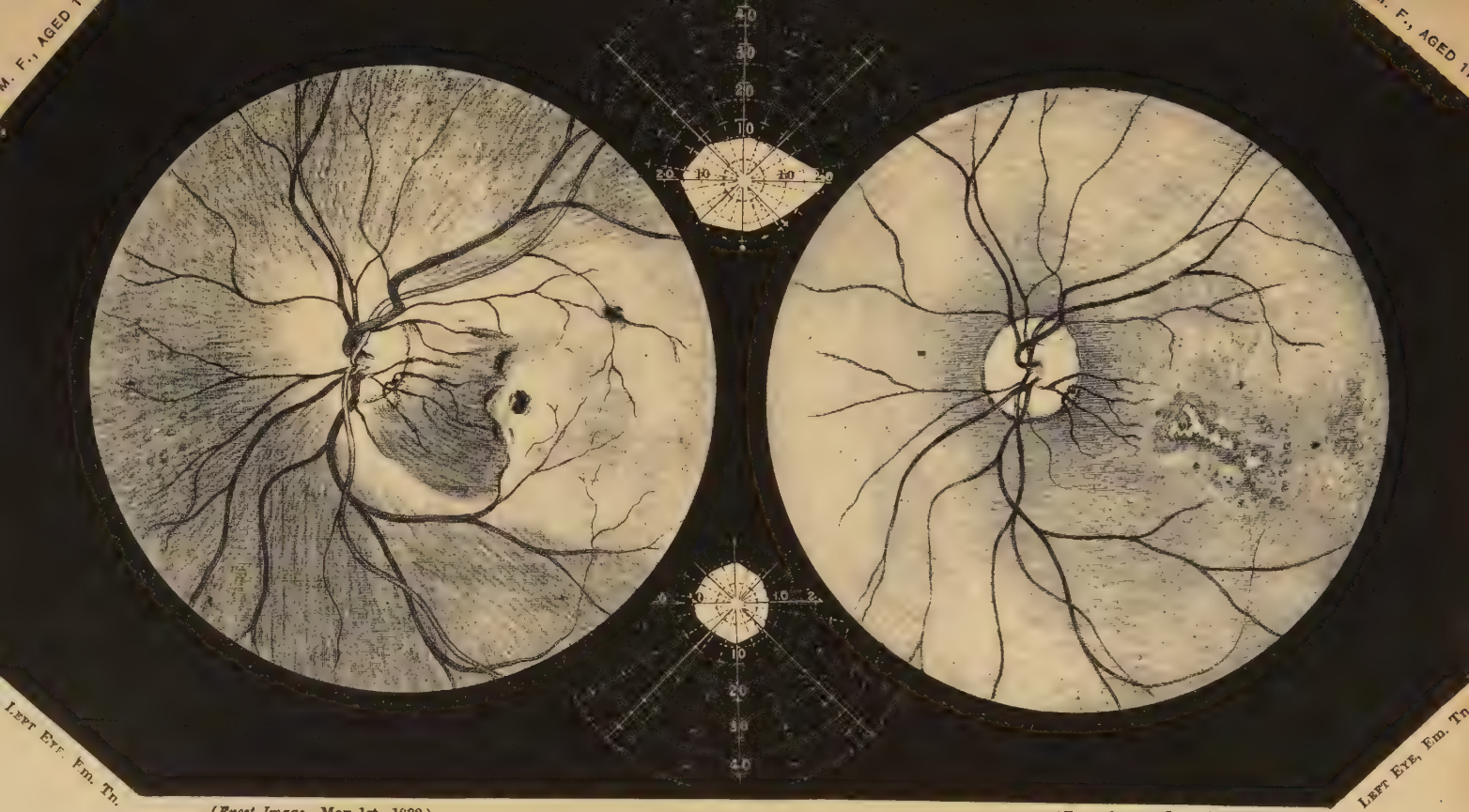
shaped patch of degeneration, much of its surface sparkling with brilliant yellow crystals. Some small bright crystals were also scattered irregularly about in the retina, from which the œdema had totally disappeared, T.n. V $= \frac{6}{12}$ and $\frac{6}{9}$, and Jäg. 1, slowly. At the outer side of the periphery, and to a less extent all round, there existed small round or oval white patches in the retina; they had well defined edges, and were nearly uniform in size, which was that of a small pin's head. They had more the appearance of exudations into than degeneration of the retina, but of their nature and cause I cannot offer any satisfactory account. The appearances were totally different from anything which I had before seen or read of.

The first question that suggests itself is, was the case really one of embolism of the central artery of the retina, or was it a thrombus in the vein, such as Michel* and Angelucci† have described, or apoplexy of the optic nerve as described by Magnus. If Angelucci's indications for differential diagnosis are to be taken as absolute, there would seem some probability that the case was one of thrombosis of the central retinal vein, but I think the weight of evidence still lies in favour of the obstruction being situated in the artery.

Had the treatment adopted in this case (viz., the continuous current) anything to do with the favourable result obtained? Many will say it had not, and perhaps they are right, but I cannot help thinking that if we bear in mind the slight improvement which had taken place since the accident, and the marked and steady improvement which followed the use of that agent; further, if we have found electricity so useful in other cases of atrophy of the optic nerve and retina, it must seem reasonable to ascribe some at least of the improvement to its employment here. Of course I do not mean to say that electricity will save a retina which is entirely and permanently deprived of blood by a complete block in the

* Graefe's Archiv. f. Ophthal., xxiv, 2.

† Annali di Ottalmologia, fasc ii, 1880.



(*Erect Image*—May 1st, 1882.)

CHART OF FIG. 1.

(*Erect Image*—June 1st 1882.)

Fig 1.

Fig 2.

Drawn from life by ARTHUR H. BENSON

main artery, but what I do say is that where you have a temporary blocking which soon gives way, but where there is strangulation of the retinal elements from the œdema, and where consequent atrophy is to be expected, not so much from loss of blood supply as from loss of functional activity, from pressure, &c., in such a case electricity may fairly be expected to benefit.

In the case I am here describing, only that portion of the retina recovered its function which had not been rendered œdematous, and which had probably not been deprived of its blood supply, but which nevertheless was struck blind simultaneously with the rest of the retina. The reason of its not becoming bloodless seems certain to be the existence of the cilio-retinal artery; but why it was in the first instance, and for so long rendered blind, is not so easily answered unless we assume the cause of the whole catastrophe to be a hæmorrhage into the optic nerve, which by pressure spoiled the conductivity of all the retinal fibre simultaneously, whilst in addition cutting off the blood supply from all that portion supplied by the central artery. As absorption occurred that portion whose circulation remained good recovered, whilst atrophy supervened elsewhere.

It was in saving this portion of the retina that I hold the electricity to have been helpful by supplying it with the stimulus it required for its nutrition during the absorption of the effusion, and perhaps also by hastening that process. It would probably have been ineffectual in restoring vision, but for the existence of the cilio-retinal vessel, and conversely it may be true that the cilio-retinal vessel might have been insufficient without the electricity.

The extreme sharpness of the line of demarcation between the œdematous and non-œdematous central patch, and its peculiar wavy line to the inner side, seems to require some anatomical explanation. It would seem as if the immediate region of the yellow spot was supplied by blood-vessels curving round from the disc, and that those vessels running directly towards the macula terminated before reaching its

immediate neighbourhood. It has been said with truth that pathology often makes more accurate dissections than the knife of the anatomist, and this may prove to be a case in point.

The appearance above mentioned would seem to depend more upon the separate vascular supply of the parts than on any arrangement of the retinal fibres, and, moreover, it appears that the cilio-retinal vessel does not really supply the region of the macula, as supposed by Mr. Nettleship in paper quoted above.

To recapitulate—the case seems remarkable—

(1.) For having occurred in a healthy person in whom no cause could be discovered.

(2.) For the existence of a cilio-retinal vessel.

(3.) For the extraordinary sharpness of the line of demarcation between the œdematous retina round the macula, and the normal patch to its inner side.

(4.) For the rapidity (less than three days) with which fatty changes occurred in the retina.

(5.) For the complete re-establishment of the circulation.

(6.) For the subsequent unusual appearances in the region of the yellow spot, and still more in the extreme periphery.

(7.) For the rapid restoration of sight whilst using electricity.

(8.) For the possible help the case may give in determining the blood supply in certain cases.

VOLUNTARY NYSTAGMUS.

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The power of voluntarily producing rapid nystagmus is sufficiently rare to justify a brief note on the subject.

Mr. George Lawson has in the last number of these Reports mentioned the case of a gentleman who possessed this power to a remarkable degree. Shortly after the date of his paper, and before reading it, a young lady æt. 24, came to consult me about a curious twitching sensation which she at times experienced in her eyes.

She told me she could make her eyes "shake" whenever she wished. I asked her to do so, and she at once set both eyes into rapid lateral motion, the excursions to each side being very short, but succeeding each other with excessive rapidity, insomuch that the corneal outline and all the details of the globe were quite obscured. In a word, the eye shuddered. The motion, as Mr. Lawson says of his case, was really an exaggeration of what is seen in ordinary lateral nystagmus, but immeasurably more rapid. It was, however, completely under the control of the will, for she could start and stop the nystagmus at a second's notice, nor was there the slightest involuntary motion visible in the eyes. There was slight hypermetropia present.

ON THE THEORY OF THE SO-CALLED KERATOSCOPY, AND ITS PRACTICAL APPLICATION.

By W. Charnley, M.A., M.D. (Cantab.)

I have attempted in this paper to give a brief account of the optical basis of the method of determining the refraction of the eye, which has been called keratoscopy or retinoscopy. The subject has already been treated by M. Parent of Paris, in two able articles which appeared in the "Recueil d'Ophthalmologie," in the numbers for February and July, 1880. I refer the reader to them for much valuable information. Mr. Morton in his work, "Refraction of the Eye," has given a sketch of the theory, and a very clear description of the practical working of the method.

As I find, however, that the subject is still unknown to not a few ophthalmic surgeons, I shall, for the sake of completeness, not only discuss the theory, but give what I hope may be a sufficient account of its application in practice; though in so doing I shall have to repeat much that has been already published. I may remark that neither of the terms hitherto used to describe the method appears quite satisfactory; keratoscopy suggesting a false theory, retinoscopy not being distinctive. Perhaps it would be best to call it "Cuignet's method," after the surgeon who first systematically described it.

What then is this method?

Suppose a patient placed in the ordinary position for ophthalmoscopic examination; the room darkened, the pupil dilated, and the gas-flame on the same side as the eye to be examined, and well to the rear of the head, so that no direct light from it reaches the patient's eye.

If we now place ourselves at about 48 inches from the patient, and reflect the light from the gas-flame into the eye in the direction of its visual axis, by means of a concave per-

forated mirror of about 9 inches focal length, we get the ordinary fundus-reflex.

Now suppose we give the mirror slight rotations about its vertical diameter, so that it "faces" in different directions, we then see something that has the appearance of a shadow moving horizontally across the illuminated area of the pupil: the edge of the shadow is seen to be vertical, and it moves (unless the observed eye be astigmatic, a subject to be fully discussed further on) either in the same direction as the mirror changes face, or in exactly the opposite direction.

If, for instance, rotating the mirror round its vertical diameter we turn it so that it faces to our right, the shadow moves horizontally either to the right or to the left. If it moves to the right, *i.e.*, in the direction in which the mirror changes face, the eye is Myopic; if it moves to the left, *i.e.*, in the opposite direction to that in which the mirror changes face, the eye is (generally) Hypermetropic. The observation we have just made is the germ of Cuignet's method. It is convenient to use the terms "with" and "against," in describing the movement of the shadow in reference to that of the mirror. For the future, then, we shall speak of the shadow moving "with" or "against" the mirror, according as it moves in the same or opposite direction to the change of face of the mirror.

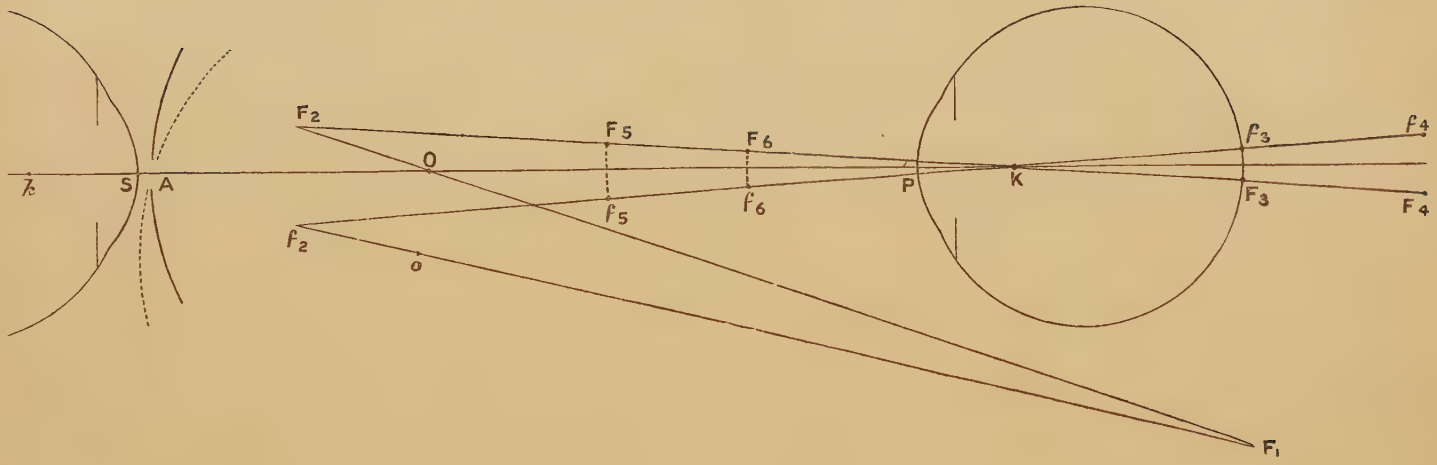
Now what is this shadow?

Suppose F_1 (Fig. 1) to be a luminous point, A the mirror held in front of the observer's eye kS, O the centre of the mirror, KP the observed eye, K being its nodal point, all these objects lying in the same horizontal plane.

An image of F_1 is formed by the mirror at F_2, F_2 being determined by drawing F_1O and taking F_2 in F_1O produced so that F_1, F_2 are conjugate foci. As F_1 is at a considerable distance from the mirror, F_2 will not be far from the principal focus of the mirror, so that F_2 is about 9 inches in front of A.

The rays of light diverging from F_2 strike the cornea of the observed eye and form an image at the point F_3 on the

FIG. 1.



retina, F_3 being the point in which F_2K drawn through the nodal point K meets the retina.

Now F_3 being a point on the retina, an image will be formed, by the dioptric apparatus of the eye, of the image at F_3, the position of which will depend on the refractive condition of the eye. This image will in all cases be somewhere on the straight line F_2KF_3; if the eye be Hypermetropic it will lie behind its nodal point, at F_4, say; if the eye be Myopic it will lie in front of the nodal point at F_5, say; the distance KF_4, KF_5 depending on the amount of Ametropia, and being the less the greater the Ametropia is. If the eye be Emmetropic the image lies at an infinite distance.

To resume: the result of the reflection at the mirror A, and two successive refractions through the dioptric apparatus of the observed eye, is that an image of the luminous point F_1 is formed at F_4 in case of Hypermetropia; at F_5 in case of Myopia, and at infinity in case of Emmetropia.

This image will be a *point* only on the condition that F_2 lies at the far point of the eye KP; in that case rays diverging from F_2 will be accurately focussed on the retina at F_3, and the image here will be a *point*, and the image formed of this image will be a *point* at F_2.

If, however, the eye KP has not F_2 for its far point, instead of a *point* of light as the image at F_3 we have a *circle* of diffusion, and, consequently, the image at F_4 or F_5 is also a *circle*.

The observer then generally sees a *circle* of light at F_4 or F_5; but in the particular instance in which the eye KP has such an amount of Myopia that F_2 is its far point, he sees a *point* of light at F_2.

If now slight movements of rotation to the right round its vertical diameter be given to the mirror, so that the point A, remaining fixed, the centre O comes into the position o, and the mirror assumes the position shown by the dotted line, what becomes of the images?

In this case the new position of F_2, which we will call f_2, is determined as before by joining F_1o, and taking f_2 in

F_1o produced, so that F_1 and f_2 are conjugate foci; f_2 is then clearly to the right of F_2, so that F_2 has moved "with" the mirror.

It is equally clear that f_3 is to the left of F_3, so that F_3 has moved "against" the mirror. What are the movements of the final images formed of the image at F_3 by the dioptric apparatus of the eye?

If the eye be Hypermetropic, the final position of the image is at f_4, so that the image has moved from F_4 to f_4, *i.e.*, "against" the mirror. If the eye be Myopic the image has moved from F_5 to f_5, *i.e.*, "with" the mirror.

In Hypermetropia, then, the image of the luminous point appears to the observer to move "against;" in Myopia "with" the mirror.

There are certain exceptions to these rules, however, which we may now consider. The observer is supposed to be placed at about 48 inches from the observed eye. Now suppose the latter to be Myopic; the final image is formed at F_5, and will be distinctly seen by the observer if he makes the effort of accommodation necessary to bring his far point to F_5. If the degree of Myopia be greater than 1 D., F_5 will be always far enough from the observer (supposed emmetropic and of good accommodation-power) for the image to be seen distinctly; as the Myopia diminishes, however, F_5 approaches S (the observer's cornea), and the image is no longer distinct. The indistinctness gets greater and greater, till at last the image is so blurred that no judgment can be formed of its movements.

If the Myopia still diminishes, F_5 falls to the left of S, and *convergent* rays fall on the cornea of the observer; these are at first so convergent that no distinct image can be formed on his retina; as F_5 passes still more to the left, they become less convergent, but now F_5 is to the left of k, the nodal point of the eye kS, so that the image of the image at F_5 formed on the retina is erect, instead of being inverted as it was when F_5 lay to the right of k. The image of F_1 then, formed on the observer's retina, has lost one inversion,

and as to each inversion of image corresponds an inversion of movement, the movement of the image in this case of low Myopia is opposite to that in ordinary cases of Myopia, where F_5 lies to the right of *k*. The image then moves "against" the mirror.

Hence, if the Myopia be less than 1 D., the movements of the image are either not seen at all (the image being so indistinct), or are "against" the mirror.

This particular degree of Myopia at which the inversion of movement takes place is determined solely by the distance at which the observer is from the observed eye.

Above, this distance has been taken as about 48 inches. If the distance were less, the degree of Myopia at which the inversion of movement took place would be greater. In fact it may be stated in general terms, that if the observer be near the far point of the observed eye, or within it, the image of F_1, formed at F_5, is either not seen distinctly at all, or moves "against" the mirror. But there are other exceptions to the general rule, which it will be interesting to examine.

Suppose the observer's eye *k*S armed with the mirror A approach the observed eye KP; then of course F_2 approaches P, and unless KP be very myopic the circle of diffusion at F_3 becomes so large that it ceases to be a distinct image, and its movements can be no longer distinguished.

As *k*S approaches still nearer KP, F_2 passes to the right of P, and rays enter the cornea of the observed eye *convergent*, but at first too convergent for a distinct image to be formed on the retina of KP.

When F_2 has passed to the right of K, a more distinct image is formed at F_3; but this is now erect with reference to the one at F_2; no inversion has taken place between these two points as is generally the case, and therefore the usual movements of the image are inverted; that is, in Hypermetropia the movement is "with" the mirror, in Myopia "against."

In the case of Hypermetropia the image is distinct, because the short hypermetropic eye is in a position to bring

to a focus on its retina the rays which now enter the cornea convergent.

In Myopia, on the contrary, the image is very indistinct, the rays falling convergent upon an eye which is adapted to bring to a focus on its retina only divergent rays; hence the movements of the image will not be so well seen as in Hypermetropia.

This movement "against" the mirror in Myopia is conditional on the far point of the Myopic eye lying to the right of the mirror, and not too near it for the observer to get a distinct image. If the Myopia be less than to satisfy this condition, the image is so indistinct that its movements cannot be appreciated, and becoming still less, the far point of the observed eye passes to the left of the nodal point of the observing eye, and the usual inversion of image produced by this eye does not take place. In this case two of the usual inversions of image are lost, one at the observed eye, one at the observing eye, and hence the image comes to move in the same way as in the ordinary case of Myopia, that is, "with" the mirror.

To sum up these movements of the image. In Hypermetropia the image always moves "against" the mirror, unless the distance of the observer from the observed eye be less than the focal length of the mirror, when the image, if distinctly seen at all, moves "with" the mirror.

In Myopia the image, as a rule, moves "with" the mirror; there are two exceptions:—

(1.) If the observer be nearer the eye than the far point of the Myopia, but not nearer than the focal length of the mirror, the image moves against the mirror.

(2.) If the observer be nearer the eye than the focal length of the mirror, but not nearer than the far point of the Myopia, the image moves "against" the mirror.

In the ordinary practice of the method, the observer being about 48 inches from the patient, the only exception that concerns us is (1) in Myopia. This we have already fully discussed.

So much for the *direction* of movement of the image; now as to the *extent* of movement.

Looking at Fig. 1 we see that corresponding to a movement of the centre of the mirror from O to *o*, the image moves in Hypermetropia through the distance F_4f_4, and in Myopia through the distance F_5f_5. Let us take the case of Myopia, and suppose the degree of it increased so that the far point of the eye KP lies nearer P, say, at F_6; on rotating the mirror through the same angle as before so that O passes to *o*, F_6 will pass to f_6. Now F_6f_6 is clearly less than F_5f_5, hence, as the Myopia increases, the extent of movement of the image diminishes.

Similarly, it may be shown that as the Hypermetropia increases the extent of movement of the image diminishes.

Further, as to the *brightness* of the image. We have seen above that only in the case of the far point of the eye KP coinciding with F_2 (M = 1 D. about), is the image of F_1 formed on the retina of the observed eye as a point; in the other cases the image is a circle of diffusion, the diameter of which increases as the refractive condition of the eye departs from this amount of Myopia in either direction, that is, either towards higher Myopia, or Emmetropia to Hypermetropia.

Now, a Myopia of 1 D. does not differ much from Emmetropia; so we may say roughly that the circle of diffusion on the retina of KP increases with the Ametropia. Since the same amount of light is in all cases concentrated into this illuminated circle, it follows that any point of this circle will be less illuminated the higher the Ametropia.

Moreover, the rays proceeding from a point of this circle of diffusion converge to or diverge from a point the nearer K, the greater the Ametropia, and are therefore dispersed over a greater angle, so that fewer rays enter an aperture of given size, like the pupil of the observer, the greater the Ametropia.

Hence the image of F_1 seen by the eye *k*S is less illuminated in the higher degrees of Ametropia for two reasons:—

(1.) Because the illumination at any point of the image formed on the retina of the eye KP is less.

(2.) Because this comparatively deficient illumination is itself diminished by the greater dispersion of the rays in their passage through the dioptric apparatus of this eye.

We see then, (*a*) that the image of the point F_1, formed by successive reflection at the mirror A, refraction into the eye KP, and refraction out of this eye moves (with certain exceptions) "with" the mirror in Myopia, "against" it in Hypermetropia; (*b*) that the greater the Ametropia, the less the extent of movement, and (*c*) the greater the Ametropia the less the illumination of the image.

What as to Emmetropia?

This may be considered as Myopia of excessively low degree, the far point being, indeed, at infinity. Hence, it comes into the category of the exceptional cases of Myopia, and the image moves "against" the mirror; and the degree of Ametropia being excessively small, the extent of movement is excessively large, and the illumination of the image at its maximum.

If instead of a luminous point at F_1, we have a flame, which may be considered as a congeries of luminous points, all that has been said above equally applies.

In this case we have formed on the retina of the eye KP an image more or less precise, according to the refractive condition of this eye; if it be Myopic to the extent of 1 D., an image is formed on the retina with sharply-defined edges, and exactly reproducing the shape (generally with our burners rectangular) of the flame at F_1. As the eye departs from this condition of slight Myopia, the retinal image will be composed of a collection of circles of diffusion, having as centres points on the retina corresponding to the points of light which may be supposed to make up the flame at F_1. This image will be then roughly circular. We have in this case formed on the retina a roughly circular illuminated area, in place of the one exactly circular, when we considered the source of light as a luminous point.

All that has been proved of the image in the one case is true of the image in the other, and the same statements may

be made as to the movements, &c., of this roughly circular image as on p. 352.

It remains to consider the *distinctness of the edge of the image*. M. Parent, in the articles before referred to, states that this distinctness is proportional to the degree of Ametropia, being the greater the higher that degree is, and even uses it as a rough test of the amount of Ametropia. I must confess my experience does not agree with his. I am, indeed, accustomed to use the intensity of fundus-reflex, and the extent of movement of the image, as an approximative test of the refraction, but I have not been able distinctly to see the variations of distinctness of edge which M. Parent describes, and the theory of the formation of the image would lead me to expect this increasing distinctness with increasing Ametropia only in the case of Hypermetropia, and not to be well-marked even then.

It may be worth while to investigate this more fully.

It has been shown above that in Myopia of about 1 D. we have an exact image of the source of light produced on the retina of the observed eye; in other states of refraction, the edges of this image are more or less blurred and indistinct; a measure of this indistinctness is the diameter of the circles of diffusion, which we have already seen are the greater, the greater the departure from a Myopia of 1 D.

Hence the greater the departure from this condition of refraction, the more indistinct the image formed on the retina of the observed eye.

It might be supposed then that the definition of the edge of the image seen by the observer would be the less the greater the departure from Myopia = 1 D. We must remember, however, that what the observer sees is not the image formed on the retina of the eye KP, but the image formed of this image at the far point of this eye. It is the definition of the edge of this latter image that we are concerned with. A measure of this definition is the diameter of the circles of diffusion in this image. This we proceed to investigate.

We take Donders' reduced eye for the purpose of our calcu-

lations, and suppose the different degrees of Ametropia produced by changes in the length of its axis.

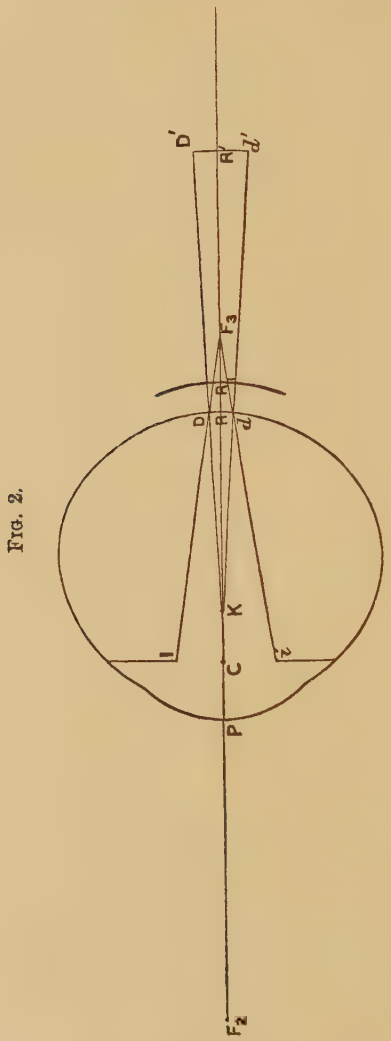


Fig. 2.

Suppose the eye KP hypermetropic to the extent of nD.; let R be its retina, R_1 the retina of the emmetropic eye, F_3

the point to which rays diverging from F_2 (supposed on the axis of the eye) converge after refraction through the eye; Ii the pupil, C its centre; l the distance from the plane of the pupil to the retina of the emmetropic eye, that is CR_1; Dd is then the circle of diffusion; its image is at $D'd'$. We have then to find $D'd'$.

We suppose all lengths expressed in millimeters.

From similar triangles—

$$\frac{Dd}{Ii} = \frac{F_3R}{F_3C}, \text{ and } \frac{D'd'}{Dd} = \frac{KR'}{KR};$$

$$\therefore \frac{D'd'}{Ii} = \frac{F_3R}{F_3C} \times \frac{KR'}{KR}.$$

Now $F_3R = F_3R_1 + R_1R$,

and $F_3R_1 = \frac{3}{10}$ (nearly), F_3 being conjugate to F_2, which is about 1 meter in front of the eye, and $R_1R = \frac{3n}{10}$*

$$\therefore F_3R = \frac{3}{10}(1 + n),$$

$$\text{and } F_3C = F_3R_1 + R_1C = \frac{3}{10} + l;$$

$$\therefore D'd' = Ii \times \frac{\frac{3}{10}(1 + n)}{\frac{3}{10} + l} \times \frac{KR'}{KR}.$$

Now R, R′ being conjugate foci with respect to the refracting surface of the reduced eye,

$$\frac{\mu}{PR'} - \frac{1}{PR} = \frac{\mu - 1}{r},$$

$$\text{where } \mu = \frac{3}{4}, r = 5.$$

$$\text{And } PR' = 5 + KR', PR = 5 + KR;$$

$$\text{moreover } KR = KR_1 - RR_1 = 15 - \frac{3n}{10};$$

therefore the above equation becomes—

$$\frac{3}{4(5 + KR')} - \frac{1}{20 - \frac{3n}{10}} = -\frac{1}{20},$$

* Cf. Donders. "Accommodation and Refraction." New Syd. Soc. Transl., Lond., 1864, p. 178.

$$\text{whence } KR' = \frac{1000 - 20n}{n},$$

$$\text{and } \frac{KR'}{KR} = \frac{200}{3n};$$

$$\therefore D'd' = Ii \times \frac{\frac{3}{10}(1 + n)}{\frac{3}{10} + l} \times \frac{200}{3n}$$

$$= Ii \times \frac{200}{3 + 10l}\left(1 + \frac{1}{n}\right).$$

. ˙ . as n increases $D'd'$ diminishes; that is, the diameter of the circle of diffusion in the image seen by the observer is less the greater the Hypermetropia. As the definition of the edge of this image is greater the smaller the circle of diffusion, we obtain the result, that the definition of the edge of the image seen by the observer is greater the greater the degree of Hypermetropia in the observed eye.

In a similar way it may be shown that in Myopia the diameter of the circle of diffusion $= Ii \times \frac{200}{3 + 10l}\left(1 - \frac{1}{n}\right)$.

This is least when $n = 1$, being then 0. In other words, the definition of the edge of the margin is greatest with Myopia $= 1$ D., the image then being perfectly distinct. This is evident from other considerations adduced above.

As the degree of Myopia increases or diminishes from 1 D., the image grows less distinct.

These variations of distinctness of image are so difficult to appreciate, that I cannot say certainly whether the above calculation is confirmed by observation or not. I find it best, if I am called upon to make a rough estimate of the refraction, without using correcting glasses, to depend not on the distinctness of the edge of the image, but on the brightness of fundus-reflex, and the rapidity of movement of the image.

We are now in a position to answer the question (proposed on p. 345)—What is this shadow?

It is simply the edge of the image of the gas-flame, formed by one reflection at the mirror, and two refractions through the media of the patient's eye.

The movements of the shadow are the movements of the

edge of the image referred to the margins of the pupil of this eye. The edge of the image is more or less circular, but as only a small part of it is generally in the area of the pupil, it will appear as a shadow with a nearly straight edge perpendicular to the direction of movement.

I recapitulate what has been proved about this shadow—

(1.) It moves as a rule "with" the mirror in Myopia; "against" it in Hypermetropia.*

(2.) The extent of movement is inversely proportional to the amount of Ametropia.

(3.) In Myopia the shadow is most distinct in a Myopia of 1 D., and diminishes in distinctness as it varies from this amount.

(4.) In Hypermetropia the shadow is more distinct the greater the Hypermetropia. [These variations of distinctness are however not easily seen in practice.]

To these may be added—

(5.) The fundus-reflex is less intense the greater the Ametropia.

The method of examination has been already briefly described. It is necessary to add a few words to that description. The side of the patient's head should be shaded from the direct light of the gas-flame by a screen; the observer, if not emmetropic, must correct his Ametropia, and the light should be thrown into the patient's eye nearly in the direction of its visual axis. If the pupil be under atropine, it may be thrown in exactly along that axis, the patient being directed to look at the mirror; if atropine have not been used, the pupil contracts so much when the light is thrown in directly, that the shadow cannot be seen easily; we must, therefore, so direct the light, that it falls on the retina somewhere near the optic disc.

We supposed above that the rotations were made around the vertical diameter of the mirror; but any other diameter, horizontal or oblique, does of course just as well. The direc-

* If the mirror be plane, or convex, these movements are reversed.

tion in which the mirror is being rotated is best appreciated by noticing the movement of the circular patch of light on the patient's eye and brow; this is the section made by the patient's face of the bundle of rays diverging from the image formed by the mirror at F_2; it moves "with" the mirror of course; its extent of movement is the best standard to refer to when we are estimating the extent of movement of the shadow.

Suppose then the patient and surgeon arranged as just directed, the light thrown into the patient's eye, and the movement of shadows observed, how do we diagnose the kind and amount of Ametropia? The following paragraphs will explain:—

If with usual gas-light the fundus-reflex is very *dull*, we infer a high degree of Ametropia; this is confirmed by the smallness of the extent of the movement of the shadow. If the shadow moves "with" the mirror, it is certainly a case of Myopia. If the shadow moves "against" the mirror it is a case of high Hypermetropia. (N.B. It is supposed that there are no pathological changes in the media of the eye to account for the dull fundus-reflex.)

If the fundus-reflex be bright, we infer a low degree of Ametropia; this is confirmed by the wide extent of movement of the shadow. If the shadow moves "with" the mirror, it is certainly a case of Myopia. If the shadow moves "against" the mirror, we cannot certainly say without further examination whether we have to deal with low Hypermetropia, Emmetropia, or low Myopia, as all these conditions give a shadow moving "against."

If the fundus-reflex be bright, but no distinct shadow can be got, but only vague indefinite obscurities, the movement of which cannot be appreciated, it is a case of very low Myopia, the far point of the observed eye falling near the nodal point of the observer's eye.

It is this condition we endeavour to bring the eye to, in estimating its refractive condition by placing glasses in front of it. It is convenient to speak of the eye in this state (that is, when with bright fundus-reflex no distinct shadow is seen)

as " corrected." It must be remembered, however, that the eye so " corrected " is not emmetropic, as the term might imply, but has a low Myopia, say about 0·50 D.

How we bring about this state of correction will be best seen from an example.

Suppose the shadow moves " with " slowly, and the fundus-reflex is dull, we infer a high degree of Myopia.

Let us put up then a pretty high negative lens before the patient's eye in the spectacle-frame, say — 8 D.

If the shadow still moves " with," we know that the eye *plus* the lens is still myopic. Let us then gradually increase the strength of the concave lens till we reach the stage where we get no distinct shadow at all, that is, the stage where the eye is " corrected." We now know that the combination of the patient's eye and the negative lens is now myopic about ·50 D.

Suppose — 9 D. the lens that brings the eye to this state; then about 9·50 D. would make the combination emmetropic; So 9·50 D. is the full measure of the Myopia. And in all cases the Myopia is about ·50 D. greater than the negative lens which " corrects " the eye.

If — 8 D, the lens originally placed in the spectacle-frame, makes the shadow move " against," we must gradually *diminish* the strength of the negative lens till we reach the " corrected " stage.

It is easily seen that the degree of Hypermetropia is about ·50 D. less than the positive lens which " corrects " the eye.

We now see how to discriminate the three cases mentioned above, viz., low Hypermetropia, Emmetropia, and very ow Myopia, in all of which the shadow moves " against."

A negative lens of ·50 D. would still leave the shadow moving " against " in the first case, would bring the Emmetropia to the corrected stage, where no distinct shadow is seen at all, and in the low Myopia convert the movement " against," into a movement " with."

I find it most convenient in practice to bring the patient's eye to the " corrected " stage, and make afterwards what

slight alterations in the glass may be necessary, in testing with Snellen's types at 20 feet. We might, instead of aiming at this stage of "correction," estimate the Myopia by the weakest concave lens which made the shadow move "against," and the Hypermetropia by the strongest convex lens which still left it moving "against."

These lenses would probably very nearly neutralise the Ametropia.

Hitherto we have supposed the refraction the same in all the meridians of the eye; that there was no Astigmatism.

We must now consider what happens in Astigmatism.

Here rays of light after passing through the dioptric apparatus of the eye no longer converge to a point; they converge to two (approximately) straight lines that lie at the anterior and posterior boundaries of the focal interval of Sturm.*

As before, let us suppose for a moment that the source of light is a luminous point; the image of this formed by the mirror at F_2 (Fig. 1) is also a luminous point, but the image formed on the retina of the eye KP is no longer a circle; it is in general an oval—an oval of diffusion it might be called. The shape and dimensions of this oval vary with the position of the retina, that is, with the refraction of the eye. For a discussion of these various shapes, &c., we must refer to Donders (*loc. cit.*). The following facts are there shown:—

If VPV′ (Fig. 3) be the meridian of greatest curvature, supposed for simplicity's sake to be vertical, and in the plane of the paper, the meridian of least curvature, HPH′, therefore perpendicular to the plane of the paper, v the focus to which rays passing from the luminous point, F_2, through the meridian, VPV′ converge, h the point to which rays from F_2 converge in the meridian HPH′; then the retina placed at v receives a linear image of F_2 perpendicular to the plane of the paper; to the left of v the image is an oblate oval; as the retina changes position from v to the right, the image of

* Donders. *Op. cit.*, p. 457, &c.

F_2 formed on it is, successively, an oblate oval between *v* and some point *o* between *v* and *h*, where it is a circle; a prolate oval between *o* and *h*; at *h* it becomes a straight line in the plane of the paper perpendicular to the axis; beyond *h* it is still a prolate oval.

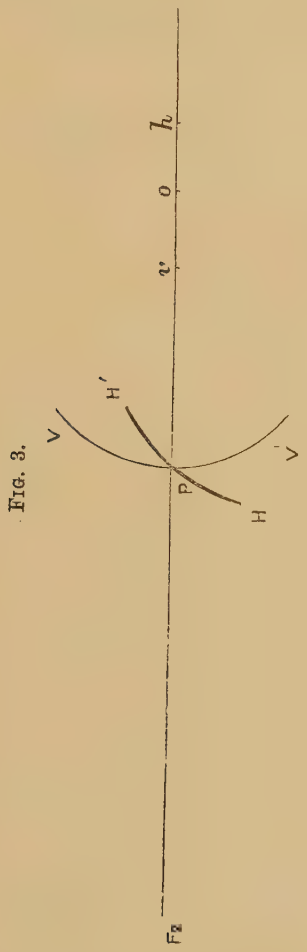


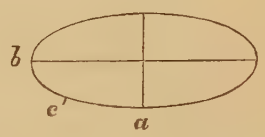
Fig. 3.

It may be shown that when the source of light is no longer a luminous point, but a flame of finite magnitude, the

image on the retina of the eye takes the shape of the area of diffusion, and is therefore generally an oval; at v this oval becomes a straight line perpendicular to the plane of the paper; at h a straight line in the plane of the paper perpendicular to the axis. What the eye of the observer sees is not of course this image, but the image formed of it by the dioptric apparatus of the eye. Where, then, will the image be formed?

Suppose the retina of the eye is situated a little to the right of the point v, then the retinal image is an oblate oval (Fig. 4).

Fig. 4.



Let us consider where the image of the horizontal edge of this oval will be formed. As before, rays proceeding from any point a on this edge will, after refraction through the unequally curved meridian of the eye, converge to or diverge from, not a point, but two straight lines (the focal lines). The image of the edge will be referred to the position where it is most distinctly seen, that is, to the position where the images of adjacent points on the edge are drawn out into ovals whose long axes are horizontal, and therefore overlap and so cause the greatest condensation of rays. Now this position is at the far point of the vertical meridian, where indeed the images of a and adjacent points are ovals so elongated that they may be considered horizontal straight lines. The position of the image of the *horizontal* edge of the retinal image depends then on the refraction of the *vertical* meridian of the eye, and is in front of, behind the eye, or at infinity, according as the eye is myopic, hypermetropic, or emmetropic. The horizontal edge, then, of the retinal image and the vertical meridian in the astigmatic eye, stand then in the same relation as the whole image and any meridian in the spherical eye.

Hence the movements of the image of the edge (itself a horizontal edge) will follow the rules already deduced, that is if the vertical meridian be Myopic the movement will be "with" the mirror; if Hypermetropic, generally "against."

Similarly the movements of the image of the *vertical* edge of the oval retinal image depend on the refractive condition of the *horizontal* meridian of the eye.

We have then as a criterion of the refraction of either of the principal meridians of the eye a shadow moving parallel to that meridian, and whose edge is perpendicular to that meridian.

Of a part of the edge of the oval near *c* intermediate to *a* and *b*, we get no distinct image formed, because the images of adjacent points are ovals whose long axes are either horizontal or vertical, whilst these adjacent points are arranged neither horizontally nor vertically with respect to one another. Hence we have only two distinct shadows; these are perpendicular to the principal meridians of refraction, that is, horizontal and vertical.

We have supposed principal meridians to be horizontal and vertical for the sake of simplicity. Frequently, however, they are oblique. In this case the distinct shadows, which are always perpendicular to the principal meridians, will also be oblique, and, further, their movements will be oblique.

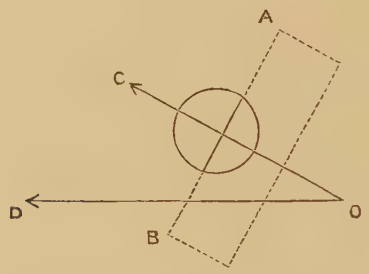
This obliquity of movement of the shadows depends on an optical illusion, and is independent of the direction in which the mirror is rotated.

Suppose, for instance, the principal meridians are inclined at an angle of 45° to the horizontal line, then the form of the retinal image is an oval with its axes at the same angle to the horizon, and therefore the two distinct shadows are also inclined at 45° to the horizon.

Now let the mirror be rotated horizontally to the right (that is, let the illuminated circle on the patient's face be made to pass horizontally to the right). Then the oval retinal image moves horizontally to the left, and the shadows, which are the images of the long and short edges of the oval, also move horizontally; whether they move to the right or to the

left depends on the condition of refraction of the meridians to which they are respectively perpendicular. But although the *absolute* movement of each shadow is horizontal, its apparent movement is always perpendicular to its own edge. This is a consequence of the optical illusion just referred to, which may be thus illustrated. Suppose we have a circular aperture, and behind it a piece of card with a straight edge, AB is passed without our knowing in what direction it is being passed.

Fig. 5.



Then the *apparent* movement is always perpendicular to its edge; that is, in the direction of the arrow C. If, for instance, the card is moved horizontally in the direction of the arrow D, it will still appear to move in the direction of C. The apparent rate of movement is the less than the real, the greater the angle between the directions of the arrows C and D. In fact if these directions meet in O, we have rate in direction OC = rate in direction OD × cos COD.

Now this is an exact reproduction of what takes place in the astigmatic eye, the pupil representing the circular aperture, and the edge of the shadow the edge of the card.

We get in this case, then, with horizontal rotations of the mirror (rotations around a vertical axis), an oblique shadow moving obliquely. This shows at once that there is Astigmatism, and shows, further, that the principal meridians are parallel and perpendicular to the shadow.

If we now rotate the mirror so that the illuminated circle on the patient's face moves in the same direction as the

shadow, we find at once that the latter moves more quickly, it being in fact now its whole motion that we see, and not merely a resolved part of it, as was the case when the rotation of the mirror and the movement of the shadow was not in the same direction.

It may be asked which of the two distinct shadows corresponding to the principal meridians do we see when the movement of the mirror is not in the direction of either of them? Suppose, for instance, the principal meridians to be inclined at 45° to the horizon, and the mirror to be rotated horizontally; since this direction of movement is equally inclined to the two principal meridians, it seems that either shadow has the same chance of being seen. The fact is, it is sometimes one, sometimes the other; but generally the shadow corresponding to the meridian of greatest Ametropia is predominant; this finds an explanation in the fact that this shadow is the most intense. *Cæteris paribus,* that shadow is most likely to be seen with whose chief meridian the movement of the mirror most nearly coincides.

Let, for example, the meridian inclined 20° to the vertical have H = 5 D., the meridian inclined 110° to the vertical have H = 3 D. The shadow corresponding to the first of these has the greatest intensity; but with horizontal rotations of the mirror, I should expect the other one to be predominant, because the inclination of the absolute to the apparent movement in the first case is 70°, in the second only 20°.

If conditions are nearly equally favourable to the production of each shadow, we do not get anything definite till we begin to correct by lenses; as then one meridian approaches Emmetropia or, more strictly speaking, a condition of M = ·50 D., its shadow becomes very faint, and then the shadow corresponding in the other meridian stands out boldly. Hence simple Astigmatism is easily detected. If the principal meridians be vertical and horizontal, horizontal or vertical movements of the mirror (which we generally begin with) do not show this incongruity of movement, and therefore do not reveal the Astigmatism. But if we make the movements of

the mirror oblique, the shadows appear horizontal or vertical, and betray the Astigmatism, and the direction of the principal meridians. The obliquity of the meridians is to be estimated by the observer's eye; of course it cannot be done exactly, but we can get within 10° probably.

We see, then, how Cuignet's method enables us to detect the two principal meridians of the eye under examination.

Having determined these we proceed to examine the refraction of one of them, transferring the movement of the mirror to its direction for that purpose. We have then as a criterion of the refraction of this meridian a shadow moving parallel to it, and with its edge perpendicular to it. All that has been proved of the shadow in any meridian in the non-astigmatic eye is true of this one meridian and the shadow perpendicular to it, and the conclusions stated on p. 357 may be repeated as applying to this particular meridian.

The movement of the shadow will then show whether it is Myopic or Hypermetropic; having ascertained this, we proceed to put up the negative or positive lenses respectively till we reach to the stage of "correction," where we get no well-defined shadow. We note the lens required, and then proceed to correct the meridian at right angles to this, making now the illuminated patch on the patient's face move in the direction of this meridian. We may now put up a combination of sphere and cylinder which corrects both principal meridians, and should then get no distinct shadows in any direction.

We now proceed to find what the patient can read at 20 inches with the correcting glass, and seeing that the stage of "correction" is one of about ·50 D. of Myopia, we should expect to have to diminish the positive or increase the negative sphere by this amount before we get the best spherical lens.

Frequently this is so.

In any case we try slight changes in the spherical lenses till we get the best vision at 20 inches, then slight changes in the strength of the cylindrical lens, and the direction of its axis.

In discussing the theory of this method of examination, I have supposed the observer to be at about 48 inches from the observed eye. This distance was suggested as convenient by M. Parent in the articles before referred to. In practice, I find a distance of about 36 inches more convenient; the patient is more within one's reach, and the correcting lenses can be changed without the examiner's getting up.

This shorter distance has the disadvantage of increasing the amount of Myopia corresponding to the stage of "correction." This is not a great drawback.

At this distance with the usual concave mirror the illuminated circle on the patient's face has a diameter of about 2 inches, or the interval between the eyes. The size of this circle will roughly indicate whether the observer is at the right distance. The surgeon should get into the habit of always placing himself at the same distance, whether it be 36 or 48 inches; and the same intensity of light should always be employed.

At the risk of reiterating needlessly, I here give a *résumé* of the procedure I generally adopt, and the conclusions that can be drawn at each stage.

The usual precautions as to light, position of the patient, &c., being observed, I direct the light into the patient's eye.

If the fundus-reflex is dull, the Ametropia is high; if bright, low.

I now make small rapid rotations of the mirror so that the circle of light on the patient's face travels horizontally and vertically in succession.

If the shadow travels horizontally and vertically respectively, there is not much Astigmatism with principal axes oblique. I now make oblique rotations of the mirror in one or two directions; if the shadow still moves parallel with the rotations, there is not much Astigmatism at all. The direction of movement of the shadow "with" or "against" has indicated Myopia or Hypermetropia.

I now proceed to "correct" the eye.

The patient is fitted with a spectacle-frame having a

double clip before each eye, and I place in the frame before the eye a positive or negative lens, according as the rotations of the mirror have shown the eye to be myopic or hypermetropic. The strength of the lens selected depends upon the judgment I have formed of the amount of Ametropia, from the intensity of the fundus-reflex, and the extent of movement of the shadow. With some experience, an approximation to the correcting lens may be made at the first trial. I now see how the shadows move in the eye armed with the lens placed in the frame. If they still move in the same sense as before, I know the eye is still under-corrected, and increase the strength of the lens in the frame, either changing it for one stronger by 1 D., or placing before it in the second clip of the frame an additional lens of 1 D. of the same sign. I test the effect of this new (combined) lens by horizontal and vertical rotations of the mirror, as before. If necessary, I increase the strength of the lens still more, by successive increments of 1 D., until either I reach the stage of correction, when no distinct shadows are seen; or the shadows move in a direction opposite to that in which they originally moved.

In the latter case I know that the eye is now over-corrected, and reduce the strength of the lens by 0·50 D. This probably "corrects" the eye. If it does not, I accept it as an approximation, knowing that it differs from the "correcting" lens by certainly less than 0·50 D., and having in view that the final test is with the types at 20 feet.

As the stage of correction is being approached, the characteristic appearances of low degrees of Ametropia are noticed, viz., bright fundus-reflex, and increased extent of movement of the shadow; not unfrequently, too, Astigmatism that had previously escaped notice, manifests itself by the appearance of an oblique shadow.

If this is not the case, and the horizontally- and vertically-moving shadows produced by horizontal and vertical rotations of the mirror disappear with the same lens, I know there is no Astigmatism.

I have now reached the stage of "correction," and am prepared to find that the "correcting" lens will have to be slightly diminished if convex, increased if concave to give the best vision at 20 feet.

If, with the horizontal and vertical rotations of the mirror, one of the horizontally- and vertically-moving shadows has disappeared before the other, or come to move in the reverse direction, I know there is Astigmatism with the principal meridians, horizontal and vertical. I proceed then to "correct" each of these meridians separately by making the rotations of the mirror in the direction of the meridian under examination, and finding what spherical lens makes the shadow moving in the direction of this meridian disappear. I put up then a sphero-cylindrical combination which "corrects" both axes, and then expect to get no shadow in any direction. I am prepared to find that this combination requires slight spherical alteration to give the best vision at 20 feet.

If at any stage of the examination Astigmatism with principal meridians oblique has manifested itself by obliquely moving shadows, though the rotations of the mirror are horizontal and vertical, I note the directions of the principal meridians, transfer the rotations of the mirror to the direction of each meridian in turn, and correct them precisely in the same way as if they were horizontal and vertical.

A few examples taken from actual practice may be useful in explaining the procedure.

Case 1. Myopia. No atropine.

Right eye. Dull fundus-reflex. Shadow moves slowly "with" in all meridians; — 9 D. "corrects" the eye; with — 10 D. letters of $\frac{20}{30}$ are read.

This follows the rule that the negative glass giving the best vision at 20 feet is rather stronger than the one that "corrects" the Myopia.

Case 2. Hypermetropia.

Right eye. No atropine. Moderate fundus-reflex. Shadow

moves "against;" + 5·50 D. corrects all meridians; with + 5 D. $\frac{20}{20}$ is read.

Case 3. Hypermetropic Astigmatism. Aphakia.

Dull fundus-reflex. Shadow moves slowly against; + 11 D. "corrects" the horizontal meridian; + 10 D. "corrects" the vertical meridian; with $\frac{+ 10 \text{ D}}{- 1 \text{ D cyl.}}$ axis horizontal $\frac{20}{20}$ read.

Here, again, the correcting convex glass has to be diminished.

Case 4. Hypermetropic Astigmatism.

Right eye. Dull fundus-reflex. Shadow moves "against." With + 8 D. a well-defined shadow moving "with" the mirror in a meridian 45° up and out; no shadow seen in meridian perpendicular to this: that is + 8 D. "corrects" this latter meridian. With + 6 D. no shadow in the meridian inclined 45° up and out; in the meridian perpendicular to this a faint shadow moving "against," that is + 6 D. "corrects" the former meridian; $\frac{+ 6 \text{ D}}{+ 1{\cdot}50 \text{ D cyl.}}$ axis 45° up and out "corrects" all the meridians, so that no shadow is seen in any direction. The lens that gives the best vision at 20 feet is $\frac{+ 5{\cdot}50 \text{ D}}{+ 1{\cdot}50 \text{ D cyl.}}$ axis 50° up and out, and with this $\frac{20}{30}$ is read, V without the cylinder being only $\frac{20}{100}$.

I have chosen these cases to illustrate the chief anomalies of refraction.

The method is much simpler in practice than long descriptions of it on paper would suggest. A few minutes' practical instruction are sufficient to teach the necessary manipulation, and the observation of the direction movement of the shadows in simple cases.

Some experience is necessary for the ready appreciation of what I have called the "corrected" stage, and still more for the estimation of Astigmatism, especially when the chief meridians are oblique.

As a qualitative test, it must be admitted that the method is unrivalled; a glance at the eye suffices to show whether it is Myopic or Hypermetropic, and generally whether it is Astigmatic or not.

There may be a difference of opinion as to its merits as a quantitative test. It has the immense advantage of all objective methods, that it does not leave us dependent on the intelligence of patients.

I think it is superior to other objective methods, especially in the ease and certainty with which it enables us to determine the principal meridians of an Astigmatic eye.

For my own part, I always employ it when I suspect Astigmatism, and in children for the correction of even a spherical anomaly. It has been extensively tried in England, since its first introduction here, and I know of scarcely an instance in which it has been fairly tested, and failed to please. The surgeon who has much to do with refraction must have no doubt many weapons at his command; I think he will do well to add to his list, if he have not already done so, this method of Cuignet.

ON THE SIZE AND POSITION OF THE CRYSTALLINE LENS IN GLAUCOMA.

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During the last two years I have made observations as to the size of the lens in eyes excised at Moorfields Hospital.

At first I contented myself with recording cases of glaucoma, in which the lens seemed unusually large. Then I made measurements in every case, whether the lens was cataractous or not.

The general result was to show that the average size of the lens in glaucoma is below that accompanying other conditions, healthy or morbid.

But this conclusion appeared to be open to the objection that the measurements of a cataractous lens furnish no criterion of its size when still clear, *i.e.*, at the commencement, in the great majority of cases, of the glaucomatous process.

To combat this difficulty, I have recorded of late the measurements of those cases only in which the lens remained clear up to the date of excision. I present all the measurements arranged under four heads, together with brief notes of each case.

To avoid all fallacy due to *post-mortem* change, I have, in almost every case, made them immediately after enucleation. But the measurements made after treatment with Müller's fluid for short periods coincide well with the others, and appear to show that this reagent produces no great, or at least no rapid, alteration in the size of the lens.

In drawing conclusions from these measurements, I have assumed that a lens transparent at the time of excision has at no previous period exceeded its then measurements.

TABLE I.—*Clear Lenses in Eyes the Tension of which is Normal or Subnormal.*

(Twelve Cases, arranged in two groups, of which the first, including five Cases, approaches more nearly the normal condition than the second.)

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 548. Mary G. R. eye excised on account of epithelioma corneæ. T.n.	62	9·75 × 3·8
No. 753. James H. L. eye excised on account of sarcoma, which occupied its outer half from near the optic disc, up to and including the ciliary body. T.n.	58	9·65 × 5
No. 580. James L. L. eye excised on account of sarcoma of the choroid. T. slightly subnormal, but not − T. 1. (The lens remained 4 days in Müller's fluid before being measured.)	52	9·1 × 3·75
No. 553. Thomas T. R. eye projected forward by a cyst in the orbit. T.n. No p.l.	22	9·0 not recorded
No. 577. Edward L. R. eye excised on account of a sarcoma behind it. V = $\frac{2}{20}$. T.n. ..	18	8·9 × 4·1
No. 754. Charles C. L. eye has detachment of retina at the macula. New growth (? myxoma) in optic nerve. The ant. chamber is deeper than normal, and the refraction is highly myopic. The iris and ciliary body give pathological evidence of previous glaucoma, though the tension was normal at excision.	50	9·9 × 4
No. 812. John F. R. eye has an infiltrated corneal ulcer from a blow with a twig 2 weeks before excision. Ant. chamber full of pus. Optic disc hazy.	57	9·8 × 5
No. 671. Thomas B. L. eye excised on account of extensive ulceration of cornea. T.n.	28	9·4 × 4·5
No. 770. Harriet S. L. eye has ulceration of cornea, with severe pain. T.n.	44	9·4 × 4
No. 809. William E. R. eye was inflamed 3 years ago, and has been defective ever since. 8 weeks ago a finger was thrust against it. There is a		

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
corneal leucoma with synechia posterior. Tension very slightly subnormal.	60	9·15 × 4·5
No. 682. James P. R. eye had + T. with ulcus corneæ and hypopyon 4 months ago. At excision the cornea was leucomatous, and the T. was normal.	33	9·1 × 4·75
No. 570. Samuel C. L. eye excised, on account of tumour of optic nerve. T.n. at excision. The clear lens is soft and yellowish in tinge. No. p.l.	65	8·8 × 4

TABLE II.—*Clear Lenses in Eyes the Tension of which was increased at Excision.*

(Fifteen Cases.)

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 759. Harriet G. R. eye excised on account of glaucoma recurring some time after the tension had been relieved by an iridectomy 2 years ago. The globe is rather large. The ant. chamber is of good depth, and the optic disc deeply cupped. The lens is opaque at the posterior pole only. It has several points of adhesion to the pupillary margin.	56	9·8 × 5
No. 734. William S. R. eye excised on account of a painful glaucoma occurring one year ago. T. 2 at excision. It was iridectomized with good result seven years ago. The lens is yellowish, and has a slight opacity near its posterior pole.	73	9·5 × 4·5
No. 696. Mary P. L. eye excised on account of sarcoma springing from choroid at outer equator, and just encroaching on ciliary body. T. 1. (The lens was in Müller's fluid two days before being measured).	49	9·5 × 3·7

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 787. Joseph P. L. eye of normal size, except that the cornea is staphylomatous at its lower part, the bulging being lined by the stretched and thinned iris. It first failed spontaneously 20 weeks ago. T. 3.	62	9·5 × 3·7
No. 618. William O. Glaucoma of several years' duration. T. 3.	54	9·5 not recorded
No. 850. Ann W. Iridectomy in both eyes for glaucoma 13 years ago, with good result. No trouble till R. became again glaucomatous five weeks ago. The lens is pressed against the cornea. The ciliary body is much atrophied, so as to leave a wide circumlental space. The iris periphery is adherent to the cornea. The vitreous is detached from the posterior pole and shrunk to about one-third its normal size. The retina is detached in loose folds. A sarcoma the size of a large pea extends from near the disk to the equator. It is many mm. removed from the lens.	43	9·4 × 3
No. 788. Sarah B. R. eye excised for painful ulcer of cornea, with hypopyon of 5½ weeks' duration. T. 2...	68	9·4 not recorded
No. 538. John M. L. eye injured 30 years ago by a powder explosion. It remained defective till two weeks ago, when it became watery, red, and painful. At excision T. 2. Retina detached and partly contracted. Ant. chamber is 2 mm. deep..	37	9·3 × 4·75
No. 675. Eliza G. R. eye excised for glaucoma of one year's duration. Iridectomy upwards was done one month ago, and sclerotomy two weeks later. The iris prolapsed into the sclerotomy wound, which became staphylomatous. An iridectomy downwards was then made without effect. T. 2 at excision.	46	9·3 × 4·5
No. 571. John F. R. eye excised for glaucoma, apparently of but five months' duration. The eye was wounded five months ago, and the cornea is now leucomatous. Measurements of globe: ant. post. 24·5 mm.; horizontal 28; vertical 23·5; O.D. hazy and somewhat swollen; veins tortuous; lens quite clear and *in situ*. The horizontal (9·5 mm.) exceeded the vertical diameter of the lens (9·1 mm.). The mean is		

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
given in the table. The lens was found to be more spherical after several weeks' immersion in Müller's fluid, each diameter being 9·05, and its thickness 4·2 mm. The astigmatism that must have resulted from the unequal tension of the lens is of interest in this case.	36	9·3 × 4
No. 672. Mary B. L. eye glaucomatous three years, with severe pain. T. 2. Cornea steamy; pupil dilated; optic disc cupped..	41	9 × 5
No. 842. James P. R. eye faded gradually five years ago from glaucoma. Suppurative iritis came on spontaneously one week before excision. The globe is of normal size.	67	9 × 4·6
No. 685. Clara S. L. eye glaucomatous one year. T. 3. Lens clear, except for posterior polar opacity.	47	8·75 not recorded
No. 563. William C. R. eye bad three weeks with gumma of iris, in consequence of primary sore 5 months ago. T. 1	57	8·5 × 4
o. 663. Robert S. R. eye injury one month ago, followed by hypopyon ulcer of cornea. Saemisch incision, followed by prolapse of iris.	46	8·5 × 3·5

TABLE III.—*Cataractous Lenses in Glaucomatous Eyes.*

(Seven Cases.)

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 537. James B. R. eye dim for 18 months, inflamed and very painful for seven months. Six months before excision there were numerous corneal infiltrations with hypopyon and T. 1, for which an iridectomy upwards was made. A Saemisch incision was made one month later. At excision the lens was close against the cornea; its hard nucleus, measuring 9 × 4 mm., was surrounded by much soft matter.	59	11 × 5·5

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 441. George S. R. eye has been fading for two years. Two months ago it became extremely painful. T. 1. Ant. chamber shallow. Lens opaque; it looks white and glistening, but is quite soft within its capsule, which is evidently distended. It looks thick in its antero-posterior direction. Measurements of globe 23 × 23 × 23.	73	10·5 not recorded
No. 640. Emma S. L. eye has been painful occasionally for five years, but much more so for the last three months. T. 2. Ant. chamber very shallow. The lens is of a peculiar translucent whiteness, and looks large and globular. Its capsule is clearly distended, and its contents are semi-opaque and soft..	40	9 × 7
No. 568. William B. R. eye accidentally found to be blind six months ago. T. 1. The diagnosis is chronic glaucoma. The specimen was 20 hours in Müller's fluid before the measurements were taken	57	9 × 4·75
No. 610. John L. R. eye blind six years from glaucoma. T. 2. There is a large staphyloma at the equator.	45	9 × 4
No. 560. John P. L. eye glaucomatous six years. T. 2. Ant. chamber 4 mm. deep. Iris tremulous; its periphery adheres to the cornea. The lens margin is removed 1 mm. at least from the apices of the ciliary folds, which, with the ciliary body, are shrunken.	44	8·5 × 3·5
No. 602. Richard B. R. eye has been blind many years, and painful occasionally for four years. The lens is distant 1·5 mm. from the cornea. It is about 2 mm. removed from the atrophied ciliary folds and ciliary body. The retina is detached. T. 3.	50	8 × 4·75

Table IV.

(Five exceptional Cases, with increased tension.)

	Age of patient.	Measurements of lens.
		Diameters. lat. ant. post.
No. 761. Edward D. Eight years ago L. eye became totally blind in the course of 12 months. At excision T. 2. The lens, opaque at its centre and poles, is partially dislocated upwards behind the iris.	64	8·9 × 5·5
No. 531. Thomas I. L. eye has kerato-iritis of very long duration with excluded pupil. Lens semi-opaque.	19	8·75 × 2·75
No. 549. George N. L. eye blind from a blow many years ago. T. 1. Total posterior synechia.	40	8·75 × 4·5
No. 635. Mary B. R. eye blind from a blow with a piece of wood three months ago. Lens partially dislocated downwards behind the iris. T. 3.	63	8 × 5·5
No. 539. Thomas C. Glioma retinæ of R. eye. Lens clear. T. 1.	4	8 × 4·25

The results are as follows :—

	Age.	Diameter.
Averages deduced from Table I :— (Transparent lenses. Normal or subnormal tension.)		
First group	42·4	9·28
Second group	48·1	9·36
Or both groups taken together ..	45·75	9·33
Averages from Table II .. .. (Transparent lenses of glaucomatous eyes.)	52·1	9·21
Averages from Table III .. .. (Opaque lenses of glaucomatous eyes.)	52·6	9·3
Averages from Table IV .. .. (The cases of increased tension not included for various reasons in Tables II and III.)	38·0	8·5

	Age.	Diameter.
But if we take the cases where the age exceeds 50 years separately, we get—		
(*a*.) Averages deduced from three cases (Nos. 548, 753, and 580) of Table I. T. n.	57·0	9·5
(*b*.) Averages from seven cases of Table II. T. in excess	62·4	9·3
If we include also with these last the cases from Table III which belong to the same period of life, we get—		
(*c*.) Average from ten cases of glaucoma	62·6	9·57

It will be noticed that even this last-mentioned diameter is not very different from 9·5, the apparent normal diameter at a rather younger period of life, notwithstanding that the two most striking of the exceptional cases (Nos. 537 and 441) are included. It is to be admitted, however, that the presumably normal lenses are but few in number.

It is clear that if the cases of Table IV had not been excluded from Tables II and III, the resulting average diameter of the lens in glaucoma would be very considerably, and probably even unduly, below the normal. The causes of their exclusion will be found in the brief notes attached to each case.

From these results of the above measurements, each made with great care and under the observation of several persons, we shall probably be justified in concluding that in glaucoma an enlargement of the lens is an uncommon and an unimportant occurrence, and that its average diameter in this disease, whether it be cataractous or clear, is even somewhat below the normal at the corresponding period of life.

With regard to the three remarkable cases of glaucoma, in which the lenses were very large (Table III, Nos. 537, 441, and 640), two only of them come within the period during which the remaining measurements were collected. One of these, however (No. 537), is not entirely free from the suspicion that the enlargement may be due to a traumatic influence.

I am disposed to attribute these comparatively rare cases to a stage in the development of cataract or perhaps rather of a certain form of cataract, occurring in glaucomatous eyes, as

in others. For the lens matter is not only swollen, but also soft and semi-opaque. A hard nucleus is present in only one of the three cases.

As far as I know, there is no pathological evidence that such a stage exists. It has long been suspected from the condition of the anterior chamber and from changes in the refraction. Becker* regards its existence as conclusively established upon clinical observation alone. Certainly the anterior chamber was encroached upon by the enlarged lens in the cases I have recorded here.

Clinical observations frequently show an advance of the lens in glaucomatous eyes, and this advance may be demonstrated *post-mortem* by properly prepared specimens in suitable cases. But in other cases of glaucoma, usually of longer standing, the lens, though probably advanced earlier, is found occupying its normal position. The anterior chamber, however, usually retains its shallow appearance from the peripheral union of iris and cornea.

The vitreous body is clearly the immediate agent of the advance of the lens, for detachments of this body by means of accumulations of fluid in front of the ora serrata, appear to be as rare in glaucoma as in other diseases.

When we find the vitreous fully occupying its chamber, we must attribute the advance of the lens to its increased size, just as the pushing back of the lamina cribrosa is due to the same cause. When, on the other hand, the fluid accumulates behind the vitreous in the subhyaloid space, we must attribute the position of the lens to an insufficient passage of fluid into and thence forwards through the shrunken vitreous. If the fluid is in the subretinal space, the retina itself must be the seat of delay.

The accumulation of fluid either within or behind the vitreous must be due either to the separation of an abnormally large quantity from the blood-vessels surrounding it, without a proportionate increase of that escaping from it into

* Handbook of Graefe and Saemisch, vol. v.

the aqueous chamber, or to an insufficient drainage in the last-mentioned direction, the quantity passing from the blood-vessels remaining unaltered.

The theory that a mechanical obstruction at the anterior surface of the vitreous prevents the outflow there of the usual fluids, and thus causes the advance of the lens, ciliary folds and iris, has been a favourite one, and the obstruction has naturally been sought at the region of greatest physiological flow, *i.e.*, close external to the lens margin.

If a mechanical obstruction checked the outflow here, we should expect to find an accumulation of fluid immediately behind it, that is to say, between it and the vitreous, just as we find the posterior chamber distended when the pupil is excluded.

The subject of anterior detachments of the vitreous has not received sufficient attention. Pagenstecher* records eight cases of enlargement of the canal of Petit, and consequent detachment of the vitreous in the ciliary region. One case of ciliary detachment is figured by Auquier.† Several have also come under my own observation. But none of them furnish any evidence that this condition bears any special relation to primary glaucoma.

It might, however, be said that fluid, checked by obstruction at the anterior surface of the vitreous, would, on account of the less firm anterior adhesions of that body, less easily accumulate here than in the vitreous itself. But even this could not account for the rarity of accumulations in the canal of Petit.

We may, however, leave this part of the question, and ask—What proof have we that such a mechanical obstruction ever exists ?

I have set myself to show earlier in this paper that physiological variations in the size of the lens are not sufficient to produce one. And if, as would appear to be the case, certain forms of cataract not commonly or necessarily associated with

* A. f. O., xxii, 2.

† Du décollement hyaloïdien. Paris, 1878.

glaucoma (*see* page 379), begin with a considerable swelling of the lens, we have an argument of considerable force.

The occasional cases in which increased tension rapidly follows traumatic swelling of the lens require further investigation. Such cases, especially if the lens be pressed against the cornea, are the only ones in which it would appear even probable that the tension is due to mechanical obstruction by the enlarged lens. We must remember on the other hand, that such swelling can hardly constitute the entire morbid change in the eye, and that comparatively few such injuries are followed by tension.

Moreover, the lens would require to be very considerably increased in diameter before it could by itself constitute an obstruction. For the surplus fluids of the vitreous chamber pass forwards, not between the lens and the summits of the ciliary folds, for the two touch under normal circumstances, but along the channels between the folds. And as these channels are ·75 mm. in depth, measuring from the lens margin to the ciliary body itself, and only ·25 mm. in width at their widest, that is, their most peripheral part, it is clear that any influence exercised by the lens would be insignificant in comparison with that produced by the swelling of the ciliary folds themselves.

But we lack pathological evidence of any enlargement of these latter. On the contrary, my observations distinctly lead to the conclusion that their average size is greater in eyes with normal or sub-normal tension than in glaucomatous eyes. Indeed, it seems indisputable that their size is directly influenced by the intra-ocular pressure, and it is highly probable that one of their functions, especially of their anterior or most projecting part, is to adapt themselves to, and to some extent regulate, the varying conditions of intra-ocular pressure.

But if there is no mechanical obstruction at the anterior surface of the vitreous in glaucoma, how do we account for the subsequent recession of the lens and for the more common occurrence of this disease, especially when associated

with shallowness of the anterior chamber, at advanced periods of life, when, according to the interesting researches of Priestley Smith,* the lens would appear to attain its maximum size?

The latter part of the question, which would appear at first sight to be associated with the size of the lens, might be explained by the greater elasticity in children of the tunics of the eye, which permits them to yield temporarily or permanently to their increased contents. In this way the increasing contents of the vitreous chamber do not require to press so much upon the lens, which in its turn has greater power of resistance owing to the greater tension of the zonula. Thus the dangers attendant on the contact of iris and cornea are frequently averted. Such cases often present themselves, in my opinion, as cases of progressive myopia.

And the recession of the lens at the later periods of glaucoma, which forcibly calls to our minds the atrophy of the ciliary body and consequent widening of the circumlental space, would be perfectly explained by the more effective obstruction which must, for the glaucoma to become permanent, have become established at the periphery of the anterior chamber, one which no increase of pressure can overcome, whereas the outflow at the zonula appears, according to Weber's recent most admirable exposition of the subject,* to be increased by the augmenting pressure behind it over that in front; the general result of the complete block at Schlemm's canal, the partial one behind, and the diminished inflow due to the ciliary atrophy and the pressure on the uveal blood-vessels, being that the pressure in the aqueous and vitreous chambers becomes equalized, and the lens regains its position of equilibrium. It may also be noted that a glaucoma cured by iridectomy may subsequently recur with a second advance of the lens.

Nor is there any proof that the lens offers any undue resistance in glaucoma to the passage of fluid through it. For cataract extraction is sometimes followed by increased

* Trans. Internat. Med. Congress. London, 1881.

tension with the characteristic advance of the iris and apposition of its peripheral part to the cornea.

Moreover, extraction of the lens from a glaucomatous eye does not seem to be more efficacious in preventing the recurrence of the tension than a simple iridectomy. And backward dislocations of the lens, whether complete or partial, are often followed, and sometimes with great rapidity, by glaucoma.

On these various grounds I fail to recognise in cases of primary glaucoma any obstruction to the normal outflow of fluid at the anterior surface of the vitreous sufficient to advance the lens. If we must have obstruction as a cause we must look for it in the vitreous itself. But we find no evidence of this, at least in the cases where this body is not shrunken or altered in structure. The same may be said with regard to the retina in relation to the accumulations found behind it, not only with choroidal tumours, but in many advanced cases of primary glaucoma.

If the increased contents of the vitreous chamber cannot be attributed to a diminution of its normal outflow, we must fall back upon the theory first advocated by Donders, of an increased separation of fluid from the blood, *i.e.*, an exaggeration of the normal process.

It would be proceeding beyond the purpose of this paper to discuss the evidence in favour of this view. It must always be difficult to produce pathological proof of a functional disturbance.

Suffice it to say, that it rests rather on the absence of contrary evidence than on positive proofs. Certainly in primary glaucoma the pigment cell layer of the ciliary body, which is presumably the principal agent recruiting the vitreous and aqueous chambers, is not the subject of any structural change which would appear to destroy its power in this direction, whereas such changes are common in the secondary glaucomas which are clearly due to obstruction at the corneal margin, *e.g.*, after perforating ulcers.

And I have found, even in the course of my usual micro-

scopic examinations, the pars ciliaris retinæ detached from the subjacent pigment layer in about 10 per cent. of the cases of primary glaucoma. These detachments are frequently so localized as to give the appearance of little fluid-containing cysts, but sometimes they are of considerable extent. Very similar changes are found in association with the cyclitis found accompanying the disease known clinically as Iritis Serosa, and which therefore should, I presume, be called Cyclitis Serosa. In this condition, however, the cysts contain some corpuscular elements. I have never found this cystic appearance of the pars ciliaris retinæ associated with normal or subnormal tension.

Does it indicate that fluid is secreted by the pigment cell layer more rapidly than it can pass onwards into the vitreous chamber ?

It is very commonly associated with so-called cystic disease of the anterior part of the retina, a condition which, though it may present itself as a senile change, is more commonly and more strikingly associated with glaucoma. Further investigation, however, is required in order to determine the precise significance of these changes and also of the enlarged afferent vessels of the ciliary body.

HOUSE SURGEON'S NOTES.

By W. J. Milles, F.R.C.S.,
Senior House Surgeon.

Iodoform in Purulent Ophthalmia.

I have employed this drug for some time past in purulent affections of the conjunctiva and cornea, and I believe that, in suitable cases, it is of very great service.

The best method of using it is either in a very fine powder, when care should be taken that it is ground down very thoroughly; or in the form of ointment of variable strength, the usual form being gr. xxx to ʒj of vaseline, the stronger form to ʒj to ʒj. The importance of iodoform in ophthalmic practice is that it produces less pain and irritation than any other antiseptic that I am acquainted with; that it can be used in a concentrated form; and that it volatilises very slowly.

Eighteen months ago I gave it an extended trial in ophthalmia neonatorum, and came to the opinion that it was only useful when one could treat the disease from the commencement (within the first two or three days). In the later stages when there was thickening of the lids, and a granular condition of the conjunctiva, I found that its effects in stopping the purulent discharge were very slight. I was more pleased with iodoform in the treatment of gonorrhœal ophthalmia, possibly from the fact that the patients suffering from this affection were more immediately under control. The treatment was combined with the use of boracic acid lotion, or a solution of perchloride of mercury (gr. i to ʒj), and, of course, a constant application of iced compresses. In a number of cases the acuteness of the swelling and the profuse discharge rapidly diminished, and the cornea was saved under this form of treatment.

Having seen the rapidity with which an indolent ulcer of the leg changes its character under the use of iodoform, I was led to try its effect on the slowly-spreading infiltrated ulcer of the cornea. It quite answered my expectations. In several cases (though other treatment had been tried without effect) with the constant application of iodoform, the ulcers ceased to spread, the infiltration of their edges rapidly disappeared, and a rapid recovery ensued.

Atropine Ointment.

The ordinary atropine solution, as I have frequently found, becomes turbid in a few days from the growth of micro-organisms. It is naturally an objectionable form of treatment to bring such a solution into contact with a recent corneal wound, whether produced surgically or otherwise. For this reason I have ceased using atropine in this form for the treatment of in-patients; and I believe that an ointment made by combining gr. iv—viii of sulphate of atropia to ʒi of vaseline is a much more satisfactory method of application.

Besides being practically aseptic, it has other advantages. It can be applied to the outer surfaces and edges of the closed lids with perfect efficacy. This fact I have tested frequently and consider to be of some importance, especially in the after-treatment of cataract operations, where it is of great importance to disturb the eyes as little as possible. Again its action is more constant than that of the solution, and lasts for a longer period. This point was shown very clearly in a case of interstitial keratitis with much photophobia and lacrimation, for directly the atropine solution was dropped into the eyes, a flood of tears washed it away, and its action was *nil;* one application of the atropine ointment dilated the pupils fully.

Spasmodic Entropion of Lower Lid.

This very troublesome affection is not an uncommon occurrence after operations on the eyes, and keeps up a great

amount of irritation. I have found that the ordinary method of treatment, *i.e.*, traction downwards of the lower lid by adhesive plaster is, as a rule, next to useless, for the lacrimation produced by the entropion soon destroys its action. The removal of a piece of skin from the lower lid of course relieves the patient in a day or two; but if the trouble, which is only temporary, can be relieved without an operation, so much the better.

The following plan proves successful. Take a piece of fairly thick soft lead wire, as is often used for styles. Mould it as accurately as possible to the face by commencing from the centre of the forehead, bringing it halfway down the middle of the nose, thence at right angles along its side, and just below the lower lid to the prominence of the malar bone; again at right angles, and now parallel to the first part to the front of the temple. Strap the two ends of the wire firmly to the forehead, and apply a bandage over the strapping. A little manipulation of the wire to the extent of lightly indenting the skin just within the lower orbital ridge, will keep the lid well everted.

A piece of thin sheet lead, shaped something like the ordinary strabismometer, often acts equally well.

Iridotomy.

A simple modification of this operation suggested itself to me, and seems to possess some advantages.

It consists in making the corneal incision in a radial manner, the outer end being at the corneo-scleral margin; that is to say, it is at right angles to the ordinary incision in the circumference of the cornea. The resulting scar is of course far external to the axis of vision.

The advantages of this modification that I have noticed are—

1st. That the incision in the cornea can be much more limited, and proportionally gives more play to the scissors.

2nd. That the knife can be plunged directly through the iris in the direction previously decided.

3rd. That the scissors are introduced and remain in the same direction, and, consequently, that they completely fill up the corneal incision and so prevent any escape of vitreous.

In the ordinary operation the scissors have to be turned through a quarter of a circle, and necessarily make the incision gape to its utmost extent, thus allowing a free escape of vitreous.

CURATOR'S PATHOLOGICAL REPORT.

By W. A. Brailey, M.D.

Cases Illustrative of New Formations in or upon the Choroid.

No. 730. Augustus D., æt. 39. Excision of *right* eye. The microscopic specimens were prepared by Dr. Lobo.

The *left* had experienced sympathetic irritation during the last four weeks.

The *right* was wounded with glass 30 years ago. Since then, though sightless, it has been free from pain.

At excision, umbrella-shaped detachment of the retina. In or on the internal surface of the choroid there is a bony layer, studded at intervals on its retinal aspect by small nodules, as if of colloid disease. Most of these are due to rounded elevations of the subjacent bone, with its covering fibrous layer. But others are made principally of yellowish granular matter, apparently altered blood, surrounded by a slightly fibrillated, but otherwise structureless outer wall. They are rounded in form, and generally pedunculated. The pigment epithelial layer is degenerated or wanting.

The bone is disposed in an irregular reticulum, formed by bands disposed at different levels, and uniting at various points. The interspaces between them contain a very delicate connective tissue, and each has at its centre a large, extremely thin-walled vessel (diam. ·04—·12 mm.), evidently an enlarged capillary.

As a rule the vessels of this layer of new formation are closely packed with blood corpuscles, among which the colourless form is unduly abundant. The blood-vessels of the subjacent choroid present this change less frequently, and in a less marked manner, though the walls of the arteries are often much increased in density and thickness.

There are, however, some areas of the choroid over which bone is absent, and the newly-formed layer in or on its internal surface consists entirely of fibrous tissue, whose dense fibres are arranged in parallel planes. But it may be that some of these fibres are replaced by bands of very much denser tissue, evidently

a stage of development into bone; while we have also occasional tracts of looser tissue, probably corresponding to the interspaces which will, when the development is completed, contain delicate connective tissue and blood-vessels. These changes into bone take place especially in the external (deeper) layers of the newly-formed fibrous tissue, so that a layer of vascular sparsely nucleated fibrous tissue of varying thickness comes to lie on the internal surface of the bone.

The connective tissue, which, with its contained capillary vessel, may fill up the interspaces of the bony reticulum, may be replaced by a yellowish granular globe (diam. ·12 mm. or more) within a hyaline or fibrous ring, the whole being very much like some of the nodules already described as projecting into the sub-retinal cavity. They appear to be capillaries which have become plugged and very much distended. Next externally to the bone-containing layers, and extending from them up to the sclerotic, is a stratum which evidently represents the choroid, for it contains a few capillaries, some larger vessels, and branching pigmented cells. Moreover, it is separated from the bone-containing stratum by a thin undulated membrane of uniform thickness, evidently the lamina vitrea of the choroid.

Thus the bone, which is recognised by its hardness, and by the presence in its structureless matrix, after maceration in chromic acid solution, of many angular brightly refracting corpuscles, is entirely on the inner choroidal surface. It is probably inflammatory in its origin, though evidence of this is generally wanting. At two spots, however, the chorio-capillaris is densely packed with inflammatory cells.

There is a fibrous layer on the posterior surface of the iris, and one also on the posterior surface of the detached retina, near the ora serrata. The latter layer contains a small amount of bone.

No. 762. William B., æt. 32, under care of Mr. Lawson. Excision of left eye. Microscopical specimens prepared by Dr. Charnley.

Right eye suffered from sympathetic irritation of two months' duration.

The *left* received a blow nine years ago. The sight went entirely away in the course of 1½ years. It has been painful for the last two months.

Globe rather shrunken. Pupil small, occluded. Iris discoloured. Ant. ch. very shallow. The retina is detached from the choroid, except just round the optic disc, where a circle of bone lies between and unites the two. The sub-retinal fluid contains crystals of cholesterine. There is also an irregular circle of bone extending all round the posterior termination of the ciliary circle.

Microscopic sections through one part of the bony ring, round the papilla, show that it rises rather steeply from the choroid into a hillock, ·75 mm. high, its diameter at the base being 1·3 mm. It is covered on its internal (retinal) surface by a vascular fibrous layer, rather thick at the summit, whence it shades off gradually towards the sides, till it soon disappears on the adjacent unaffected choroid. Underneath this fibrous layer the several imperfect layers of bone, of which the hillock is mainly made up, unite with one another irregularly. The interspaces between them contain thin-walled blood-vessels, probably dilated capillaries, embedded in very delicate connective tissue. The whole is separated from the subjacent choroid by a thin, homogeneous, much undulated membrane, probably the vitreous lamina. Beneath it are a few capillaries, probably those of the chorio-capillaris, and, deeper still, the larger choroidal vessels. The tissue of the choroid at the seat of the new formation is a little thinner than elsewhere.

The other bony ring is situated on the internal surface of the choroid, immediately behind the ora serrata. It lies in the midst of a fibrous layer which, gradually diminishing in thickness, runs for some distance along the internal surface of the adjacent choroid. In places a very distinct undulating thin lamina can be seen to separate the fibrous and bony layers from the choroid proper. This separation becomes much more distinct as we pass backwards.

No. 782. Wm. R., æt. 34, under care of Mr. Couper. Excision of left eye, on account of recent sympathetic irritation. Microscopic specimens prepared by Dr. Lobo.

The eye was wounded thirty years ago, and has had no perception of light since. It is shrunken to two-thirds its size. Its cavity is nearly filled by a bone-containing mass, situated in or on the choroid. A tough, fibrous, non-vascular layer bounds this mass internally, and separates it from the contracted retina.

The total thickness of the new formation is about 3 mm. Its relations are the same as in the specimen No. 730. Its structure is also the same, except that its connective tissue shows a few stellate pigment cells, and that its inner fibrous stratum is not quite so inconsiderable relatively to the entire thickness of the new formation.

In the deepest part of the mass, or, more often, on its external surface (*i.e.*, that near the choroid proper), we encounter many large bodies (diameter about ·01 mm.) which in section show an outer, more or less thick, structureless, opaque wall, enclosing a central cavity, which is plugged with yellowish granular matter. These appear to be dilated and obstructed blood-vessels, and they remind us of the bodies met with in Case No. 730, in the choroid, and also in or on the newly-formed layers internal to it. Their size and general disposition are much like those of the immediately adjacent bony rods, and it does not appear altogether improbable that the latter were originally derived from the conversion of blood-vessels and their contents into bone. The anastomosing rods of bone are loosely arranged, and their larger interstitial spaces are occupied by extremely delicate connective tissue, in which are found small arteries with much-nucleated walls, and also a moderate number of very fine capillaries. The stratum, which appears to represent the choroid proper, though denser and containing more pigment, is on the average only ·2 mm. thick, and contains very few blood-vessels of any description. It is separated in places from the bone-containing layer by a delicate-looking undulated lamella, which appears to represent the remains of the internal limiting membrane of the choroid (lamina vitrea).

The ciliary body is clothed on its inner surface by a tough membrane, which is pigmented in its deeper part. A similarly pigmented fibrous layer, containing some bone and a few blood-vessels, lies on the anterior part of the choroid, and is bounded on its external surface by a thin, structureless-looking, much-undulated lamella, which can be traced as a direct continuation of the outermost of the two lamellæ which normally separate the connective tissue of the ciliary body from the overlying pigment cell layer and pars ciliaris retinæ. This continuity of the membrane, coupled with the presence of pigment in the anterior part of the newly-formed stratum, makes us yield to the

belief that the latter, both here and further back, is situated on the *internal* surface of the well-defined lamella, which limits the choroid internally (the lamina vitrea, as commonly seen). The anterior part of the choroid is thick and fibrous in its external layers.

No. 736. John P., æt. 34, under care of Mr. Tay. Excision of *right* eye, which is shrunken from corneal necrosis after gonorrhœal ophthalmia, beginning four months ago.

The cornea can scarcely be traced; the retina is detached; the choroid is *in situ*. In two places near the equator we encounter, near the junction of sclera and choroid, a well-defined rounded cavity, which contains dark blood. Such cavities have quite a cyst-like appearance, but their continuity can be demonstrated by the aid of a probe. Their course is very extensive, and they give off ramifications.

Microscopic sections, prepared by Dr. Lobo, show that the main cavities have smooth walls, and are situated in the midst and parallel to the surfaces of a thick fibrous stratum, which occupies the position of the lamina supra-choroidea. This stratum is separated from the sclerotic by a loose layer of branching pigment cells, which is sometimes split by means of an intervening cavity into two secondary layers, which evidently represent the pigment of the lam. supra-choroidea and lam. fusca. The cavity consequently represents the peri-choroidal lymph space. It may be of very considerable size, but this is probably due mainly to the process of preparation, and it is doubtful if it ever produces the cyst-like appearance described as visible in this specimen to the naked eye.

The fibrous stratum (the supra-choroid) is as much as ·5 mm. thick, whereas the remainder of the choroid to the very summits of the undulations of its internal surface measures only about ·3 mm.

The sclerotic and supra-choroid, though both fibrous, contrast strongly in appearance, for the fibres of the latter are parallel to its surfaces, and show numerous nuclei, whereas those of the sclerotic, as is commonly the case in atrophied eyes, are sparsely nucleated, and very much undulated.

The remainder of the choroid is diffusely hypernucleated, and contains an excess of dark brown branching pigment cells.

The lamina vitrea is much undulated, but not at all thickened. The pigment epithelium of its internal surface is very irregular, but its pigment is generally unduly abundant and dark in colour. There is no new formation on the inner choroidal surface.

No. 737. Fredk. D., æt. 32. Excision of *right* eye. The *left* looks perfectly healthy, but has watered a little at times for many years past.

The *right* was lost more than ten years ago, from a spontaneous inflammation, apparently an iritis. It has been painful occasionally for several years, but much more so within the last fourteen days. It is somewhat shrunken. There is ciliary injection. The atrophied iris is thrust against the cornea. Perception of light is wanting. After excision we find umbrella-shaped detachment of retina and sub-retinal space entirely filled by a mass which has the same structure and arrangement as in Specimen No. 782.

In many places we can trace on its external surface a thin, uniform, much-undulated membrane, evidently representing the choroidal vitreous lamina. The choroid proper, which underlies this, is, in its external layers, very dense and fibrous, so that the lamina supra-choroidea looks not unlike the adjacent sclerotic. But the two are separated in places by an extensive interspace, probably the peri-choroidal space. The rest of the choroid is thinner than usual, and contains more fibrous tissue. Its vessels, comparatively few in number, have thick walls. The microscopical specimens are not very good.

No. 217. John J., æt. 24. *Right* eye excised by Mr. Lawson. The *left*, which was always very myopic and otherwise defective, was injured ten months ago by a small piece of steel. It has been painful for the last two days.

The *right* has always been extremely defective. He knows of no cause for this. It never squinted. An iridectomy was made in it nine months ago. *At excision* its tension is diminished: there is a large artificial coloboma outwards. The retina is detached: there is a thin pale yellow fluid between it and the choroid, which remains *in situ*. The optic disc is surrounded by a bony plate through which the pedicle of the

detached retina runs. There are other smaller patches of bone on the inner choroidal surface, as well as a very imperfect bony circle just behind and parallel with the ora serrata.

Meridional sections of the ciliary body and iris show a considerable increase of inflammatory cells in their connective tissue, especially near the junction of the two. These are also very abundant round Schlemm's canal. In the anterior part of the choroid and adjacent posterior part of the ciliary body they are arranged in masses something like those of uveitis maligna. On the internal aspect of the posterior part of the ciliary body and adjacent choroid is found a fibrous layer, which, *in front of the ora serrata*, bears the remains of the pars ciliaris retinæ on its internal surface, and in its deeper layers many pigment cells. The same *behind the ora serrata* contains some pieces of bone. A homogeneous structureless lamina, evidently the lamina vitrea, separates the bony and fibrous mass from the choroid proper. The presence of the newly-formed fibrous and pigmented layer distinguishes this inflammation from the typical choroiditis maligna of sympathetic disease.

At another point of the ciliary circle the same changes are seen in a less advanced condition. The proliferated pigment cells and many unpigmented ones are disposed in a soft fibrous tissue on the internal surface of the vitreous lamina.

At the *posterior part* of the choroid the bony plates lie in the midst of much nucleated connective tissue. They contain cavities occupied by similar tissue and some blood-vessels. A delicate undulated uniform membrane separates the mass from the subjacent choroid proper, in which many cells are distributed in clusters in a manner which is occasionally slightly suggestive of choroiditis maligna. The sclerotic contains more nuclei than normal.

Judging from the numerous well-developed bone corpuscles, and from the numerous nuclei of the connective tissue in which it lies, it would appear that the new-formed bone is in a high state of nutrition. In this case we see none of the dense fibrous tissue which in other cases lines the bone on its retinal aspect.

No. 821. Wm. B., æt. 39. *Left* eye excised by Mr. Streatfeild, on account of its producing sympathetic irritation. Its sight was lost from a blow five years since, but it gave him no

trouble till seven months ago, when it received a scratch from an iron nail. Since then it has been painful at times.

At excision its size and tension were normal. The shrunken lens was dislocated. The detached retina contained within its cavity a mass of cholesterine, and was separated from the choroid by a fluid containing cholesterine crystals. The choroid is dark in colour, but otherwise appears normal. The upper part of the ciliary body bears on the inner aspect of its posterior half a hard, white, bone-like mass.

Microscopic examination (by Mr. Hartridge) shows that this mass is in reality osseous, containing numerous bone corpuscles. It is traversed by tracts of vascular connective tissue. It lies in the midst of the irregularly proliferated pigment of the ciliary body. The latter is much thinned and atrophied where it underlies the new formation. Elsewhere, though somewhat hypernucleated, it is neither atrophic nor is its pigment proliferated.

No. 566. Wm. T., æt. 14. Excision of *left* eye by Mr. Tay. *Right* normal.

The *left* is shrinking from an injury with a pocket-knife four years ago. Now it is sightless and painless.

The cornea is clear, and the iris discoloured. The lens area is occupied by a white opaque hard plate, resembling bone. The retina is detached, and the sub-retinal space contains a pale yellowish-red fluid in which are cholesterine crystals. The choroid is *in situ;* on its internal surface are several prominent nodules, some even 1·5 mm. high; ridges sometimes connect adjacent ones.

Microscopic sections, by Dr. Lobo, show that the nodules are made of concentrically-disposed, somewhat fibrous, laminæ, between which are numerous bone corpuscles and occasional brown pigment granules. The superficial laminæ form a comparatively unstained zone. Then, as we leave the surface, the staining becomes rather suddenly a little deeper. Towards the centre the fibres are more irregularly disposed and between them, or in a central more or less well-defined cavity, is a yellowish granular matter, intermixed with which are many colourless acicular crystals. These contents are probably the remains of blood.

The nodules, though sometimes sessile, are generally pedunculated, often by an extremely narrow neck. This is sometimes implanted on a bony plate which forms a base, gradually thinning towards its margin, and resting on the subjacent choroid. The latter is generally normal, except that it is a little thinner, and its stroma is rather more pigmented at these spots. Its unchanged lamina vitrea can often be traced as a delicate homogeneous line which separates the choroid from the new formation.

No. 248. Susannah H., æt. 17. *Right* eye excised by Mr. Hulke. The *left* has been irritable for the last six months.

In infancy she had ophthalmia neonatorum which left the *right* blind. She has had no trouble with it till six months ago, when pain came in and over it. At excision it is shrunken and extremely hard (T. 2). The cornea is small and cicatricial, with thinning at its upper margin. The retina is detached and contracted. The internal surface of the choroid is studded with greyish nodules, most of which are sessile by a broad base. Some are as much as ·25 mm. in height.

The microscope shows them to be on the internal (retinal) surface of the lamina vitrea, which is almost everywhere unchanged. Most of the nodules are covered by enlarged and darkly pigmented cells of the pigment epithelium layer. Many stain very deeply and uniformly with hæmatoxylin. But in some this staining is limited to the central part. Others, especially the smaller ones, remain entirely unstained. For the most part no structure can be detected in any of them, though occasionally, large faintly-staining oval nuclei can be seen in them. In two cases, however, the deepest part of the nodule is packed with closely arranged parallel elongated nuclei; and similar nuclei occupy in these cases the corresponding part of the chorio-capillaris, the two being separated by the delicate unaltered lamina vitrea. In one of these cases that part of the new formation which occupies the chorio-capillaris contains some bone corpuscles, so that the colloid nodule is capped on its deep surface by bone situated in the chorio-capillaris.

On the external surface of the pedicle of the detached retina there is a layer of fibrous tissue which contains some small osseous formations. A continuation of the choroidal vitreous

lamina can be traced for some distance on the commencement of this pedicle. In this position it is distinctly thickened, and bears colloid bodies and the remains of pigment cells.

No. 63. Charles B., æt. 23. Excision of *right* eye by Mr. Streatfeild. *Left* sympathetic irritation for the last six months.

The *right* was wounded with scissors sixteen years ago. He has had neither perception of light since, nor any pain.

At excision it is rather smaller than the average, though the tension is normal. The retina is detached into an umbrella shape; the choroid, which is *in situ*, has conspicuous nodules projecting from its internal surface. These are found by the microscope to lie between the choroidal vitreous lamina and its pigment epithelium. They are limited to the posterior half of the eyeball, and are comparatively few in number. Their size varies greatly: the largest are ·3 mm. in height, some are pedunculated, but the majority are sessile by a broad base. The cells of the pigment epithelial layer overlying them are often large and unduly dark in colour, but they may be wanting altogether.

The new formation may either show large feebly staining nuclei embedded in a structureless matrix, the whole having somewhat the appearance of a so-called giant-cell; or it may be entirely structureless, in which case there may be a slight concentric lamination. Or its more projecting portion may be structureless, while that part in contact with the vitreous lamina either shows nuclei in a structureless matrix or consists of nucleated fibrous tissue, in the centre of which there is a plate of bone. Thus, we may have a true ossification on the internal surface of the vitreous lamina like in kind, but much less in degree than in the cases previously described.

The new formations take the hæmatoxylin staining very variously, from a weak diffuse coloration to a diffused intensity, which almost prevents the recognition of the enclosed nuclei.

The capacity of staining is retained longer by the central and deepest parts.

The lamina vitrea is not thickened. In the choroid generally there is a moderate degree of hypernucleation, which is rather more conspicuous in the spots whence the projecting

nodules take their rise. Here also the choroid may be slightly thinned.

The generally unatrophied ciliary body presents certain points where its pigment epithelium is thickened and intermixed with newly-formed fibrous tissue. The part of the ciliary body immediately underlying these spots is atrophied so that they form comparatively inconsiderable projections into the vitreous chamber.

The anterior part of the choroid presents many small nodular elevations, to the formation of which the enlarged pigment epithelium cells conduce either partially or entirely.

No. 231. Dinah H., æt. 36. *Right* eye excised by Mr. Hulke, on account of sympathetic irritation. The sight was lost 19 years ago from a blow with a piece of wood, which partially dislocated the lens. Now there is an opacity at its posterior pole, and almost complete absorption of the vitreous. The retina and choroid are *in situ*. They present several pigmented spots, in appearance exactly like those of choroiditis disseminata. Microscopic sections through these spots show that the choroidal vitreous lamina is unchanged, while its pigment epithelium is irregularly thickened and unduly black. In the midst of this hypertrophied epithelium, or on its internal surface, are many large deeply-staining nuclei, apparently those of inflammatory cells of new formation. Sometimes these cells are replaced by sparsely nucleated fibrous tissue, in which case the pigment epithelium cells cannot be traced. The retina and choroid cohere at these points; elsewhere they are separated.

A small piece of bone is found embedded in the choroid in the immediate neighbourhood of the optic disc. The choroidal layers which separate the bone from the sclerotic contain numerous brown pigmented stroma cells; the narrow stratum by which it is separated from the unthickened lamina vitrea contains numerous elongated staining nuclei, arranged parallel to its surface. There is a mass of unpigmented nucleated exudation on the internal surface of the lamina vitrea corresponding to the bone.

No. 189. Solomon N., æt. 42. *Right* eye excised by Mr. Wordsworth on account of sympathetic irritation. The eye is

shrinking after an iritis, which began five years ago. The retina is detached; the choroid remains *in situ*. At one part of the inner surface of the latter membrane is found a dense sparsely nucleated fibrous layer, which is separated from the subjacent partially atrophied choroid by a very delicate, homogeneous-looking, much undulated membrane, which is the lamina vitrea. At other points there are colloid masses, and numerous enlarged, very dark, epithelial cells. The lens is represented by a calcareous-looking shell. A tough pigmented membrane is found at one point only of the internal surface of the ciliary body, representing a very much localised cyclitis. The cause of the inflammation is obscure. It may be syphilitic.

No. 760. John A., æt. 54. Buphthalmic condition of *right* eye since infancy. Tension normal at excision, which was performed by Mr. Streatfeild in consequence of occasional attacks of pain. The lens and vitreous are almost entirely wanting. The choroid and retina are *in situ*. They present numerous black pigment spots, very much resembling those of retinitis pigmentosa.

Microscopical examination shows that the black spots are due to an increase in the pigment on the inner choroidal surface. It is extremely black and irregular, being in some places entirely absent. At one point a small dense fibrous and bony plate is seen imbedded in the pigment, and near it, but in the centre of the choroid itself, we find a similar, though much smaller plate. There are no inflammatory cells in the choroid. Its lamina vitrea is not thickened at any point. The ciliary body bears a pigmented membrane on its internal surface.

No. 84. Mary Ann Kelly, æt. 24. Her *left* eye is blind from ophthalmia neonatorum. She has occasional pain in it. Its tension is normal.

The leucomatous cornea presents a minute fistulous opening. The iris adheres to its posterior surface as a pigmented web. There is no lens. The optic disc is white.

The choroid and retina are *in situ;* the latter is mottled with dark pigment, giving an appearance somewhat like that of retinitis pigmentosa.

Microscopical Examination.—The retinal pigment epithelium

stratum is either entirely absent, in which case the outermost retinal layers are also wanting and the retina and choroid cohere, or the pigment is irregular, unduly abundant, and black. A small plate of bone is found close to the optic disc. It is difficult to be satisfied as to its exact position; but there is some evidence that the unthickened lamina vitrea of the choroid is on its external surface. It is overlaid on its inner surface by a fibrous stratum, apparently the remains of that in which the bone was developed. At other places pieces of bone are found enclosed in the very midst of the hypertrophied pigment epithelium layer.

No. 347. Thomas Ridgley, æt. 12, under care of Mr. Lawson. His *right* eye was lost soon after birth by perforating ulcer of the cornea, consequent on ophthalmia neonatorum. Its tension is much increased at the time of excision.

Microscopical Examination.—The relations between retina and choroid are almost exactly the same as in the previous specimen, except that the position of the bone *in* the hypertrophied pigment epithelium layer is more clearly apparent here, and that several large colloid-looking masses occupy the same position. There is a tough pigmented membrane on the inner face of the ciliary body.

No. 34. Sarah Wine, æt. 13. *Left* eye is large and staphylomatous in front, in consequence of an old perforating ulcer, due to ophthalmia neonatorum. There is a small, but rather thick plate of bone *in* the choroid near the optic disc. It occupies the greater part of the thickness of that membrane, the chorio-capillaris only remaining uninvolved. The latter is occupied by a considerable number of inflammatory cells. The lamina vitrea over it is unthickened. Its pigment epithelium is increased, irregular, and unduly black in colour. In some places it extends into the external layer of the subjacent retina. The ciliary body bears on its inner aspect a thin layer of new formation.

No. 335. Edmund M., æt. 20, under care of Mr. Couper. His left eye is shrunken in consequence of a spontaneous inflammation, apparently an iritis, four years ago, which affected the right eye also three or four months later. He has every appear-

ance of congenital syphilis, and his family history is consistent with this. Between the retina and choroid is a layer of dense fibrous tissue, much thicker than either. It is sparsely nucleated, and contains embedded in it at one point a bony mass of considerable size.

The choroid contains more nuclei than normal. Its vitreous lamina is unthickened and much undulated. The pigment on its internal surface may be very black, irregular, and much thickened, or it may be wanting.

No. 776. Jane R., æt. 60. *Right* eye excised on account of corneal staphyloma and glaucoma, secondary to corneal ulcer ten months ago. It has been occasionally painful. The retina and choroid are *in situ*. On the internal surface of the latter are many elevations, mostly small, but some as much as ·08 mm. in height. Most, when viewed on the flat, are darker in colour than the surrounding choroid. Some have an uncoloured centre, but are surrounded by a ring of dark pigment; others are entirely unpigmented.

Microscopic sections show that the dark raised spots are due to a new formation, either entirely structureless or containing a few nuclei, between the hypertrophied pigment epithelium and the unaltered vitreous lamina. It would appear as if the earliest condition of the new formation were that in which the structureless matrix contains a few nuclei, and is covered by darkened pigment epithelium, and that the entirely structureless form with diminishing covering pigment were a product of retrograde change.

The choroid shows some increase of its nuclei. These are, however, distributed most abundantly in its middle layers, and not in any special relation to the exudations on the inner surface of its vitreous lamina.

No. 695. Margaret H., æt. 25, under care of Mr. Streatfeild. Excision of the *right* eye, which was needled eight years ago on account of cataract. Now, it has no perception of light, and is, moreover, occasionally painful. The *left* eye has lately become irritable. In the *right* the retina is detached; the choroid *in situ*. On the internal surface of the latter we see many small elevations, the largest being ·07 mm. in height. They are

on the internal surface of the vitreous lamina, and appear to consist, at all events in larger part, of enlarged amyloid-looking cells of the pigment epithelium layer. Such separate cells are abundantly seen over the internal choroidal surface in the form of minute isolated nodules, diam. about ·01. Each has a large nucleus, which stains with the hæmatoxylin a little more deeply than the substance of the cell itself, to which this reagent gives only a slight diffuse blue coloration. The pigment granules are scattered over the surface of the cell, and are much less dark than normal.

No. 329. Margaret P., æt. 21. *Right* eye excised by Mr. Lawson, on account of its causing sympathetic irritation.

It was injured with a fork eight years ago. The retina is detached and partly contracted; the choroid has some minute dark elevations on its internal surface. These are caused by the presence of structureless material between the unthickened vitreous lamina and the pigment epithelium. It is clearly distinct from both. The epithelial cells overlying it are enlarged and very dark. Cells of the epithelial pigment layer at other points may be enlarged and degenerated, so as to form spheres projecting beyond the level of their darker-coloured neighbours. The nuclei of the choroid are more numerous than normal, but their distribution bears no particular relation to the presence of the colloid formations.

Fig. 1.—Microscopical section of the choroid of No. 636, to show the thick fibrous layer in the external part of the choroid. The choroid is above, and a part of the sclerotic is visible below. The lower gap (on the left) is between the fibrous layer and sclerotic; the uppermost (on the right) is in the fibrous layer itself.

Fig. 2.—Section showing a part of the sclerotic, choroid, and detached retina of No. 63. A *colloid body* which contains a few nuclei, is continuous at its base, with a bony plate, which is internal to the unaltered lamina vitrea. The very considerable gap which exists between the choroid (above) and the sclerotic (below) is due to an accident in the preparation.

Fig. 3.—Section from No. 782, showing the bony network which nearly fills up the cavity of the shrunken eyeball. The choroid is the narrow dark band at the lower edge of the specimen. Between it and the bone are the peculiar rounded bodies described in the text.

Fig. 1.
× 35.

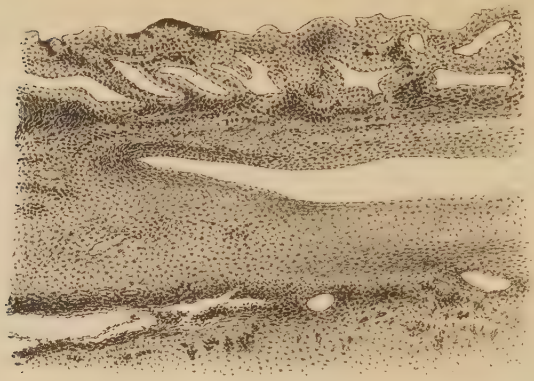


Fig. 2.
× 85.

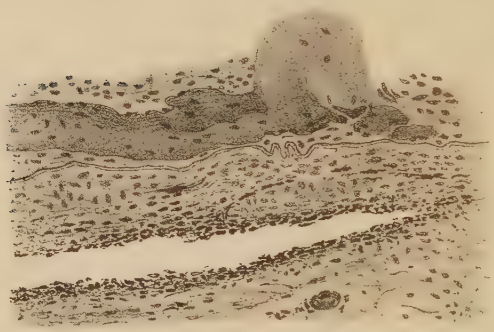
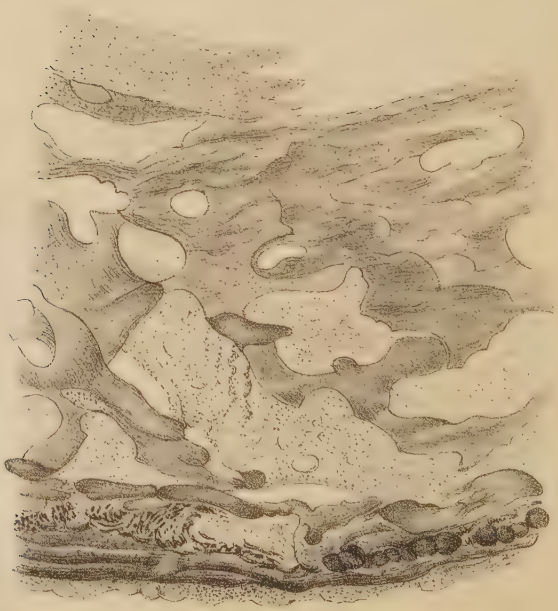


Fig. 3.
× 16½.



ON CHOROIDAL NEW FORMATIONS.

By W. A. Brailey, M.D., and Dr. Gama Lobo.

Choroidal New Formations may be bony, fibrous, or structureless, or they may present these various conditions in combination. They may be within the choroid, but are more commonly seen on its external surface.

One of the most striking of these consists in the development of a highly nucleated fibrous stratum between the bulk of the choroid and the sclera (*see* Plate, fig. 1). The newly-formed tissue, which looks to the naked eye like a somewhat thinner repetition of the sclera, probably represents the vastly thickened Lamina Suprachoroidea. It is separated from the sclera by a thin pigmented layer, the lamina fusca, and it has on its inner surface the rest of the choroid in the form of a pigmented layer, which contains many dilated thin-walled blood-vessels. It is more highly nucleated than the sclera, and the general arrangement of its component fibres is parallel to its surfaces, whereas the more distinctly differentiated scleral fibres have in these cases, as indeed is generally the case in shrinking eyes, a much undulated arrangement.

The Tunica Vasculosa cannot be traced with certainty as a distinct layer. It is most probable that the bulk of it is absorbed into this fibrous tissue stratum, so that the latter will represent not only the lam. supra-choroidea but also part of the tunica vasculosa.

The cavities by which this fibrous layer is traversed are very large. Indeed they give in section the appearance of cysts. Their continuity and their blood-like contents support the view that they are dilated blood-vessels. They have, however, no special walls of their own, but appear to be simply channelled in the highly-nucleated tissue which they

traverse in a direction parallel to its surface. In certain specimens a considerable cavity, which appears to represent the peri-choroidal lymph space, exists on the external surface of this layer (*see* Case No. 736).

The other new formations which attract most attention are the Osseous, either in the choroid or on its inner surface, and the so-called Colloid bodies which occupy the latter position.

But the two formations are intimately related, for it is by no means uncommon to find colloid nodules and bone associated in the same specimen. And we may even find bone corpuscles in such nodules or a plate of undoubted bony tissue on the lamina vitrea in immediate relation with them.

Bone is rare *in* the choroid in comparison with its occurrence on the inner choroidal surface, *i.e.*, on the retinal aspect of that conspicuous, delicate, homogeneous-looking lamina which, in ordinary microscopical sections, is seen to limit the choroid internally, and which we shall designate in this communication the Lamina Vitrea.

When bone is found within the choroid, it usually occupies the chorio-capillaris. In some cases it attains a much greater thickness than the normal chorio-capillaris, and then the remaining choroidal layers are thinner than normal, more pigmented and, as it were, compressed together. The formation of bone in the choroid does not proceed immediately from the lamina vitrea. Indeed, in many instances, there is a distinct interval, containing however many elongated nucleated cells between the latter and the newly formed bone. This may be the case even where bone consists on both aspects of the lamina vitrea.

Bone developed on the inner surface of the lamina vitrea may lie in the midst of the proliferated pigment epithelial layer. Such cases are not uncommon in wounds and perforated ulcers of long standing. In such cases the origin of the bone from the proliferated pigment epithelium is beyond doubt. And we may say the same with regard to the hard

nodules or bony plates which are sometimes found in or on the external layers of the detached retina.

In other instances one or more bony plates lie on the inner choroidal surface in the midst of a vascular highly-nucleated tissue. In these, the origin of the bone from the pigment epithelium is open to question, as all traces of the pigment cells may be wanting.

The several imperfect layers of which the thicker masses of bone are composed have, in section, the appearance of irregular anastomosing rods, the interspaces of which are occupied by an extremely delicate, moderately vascular connective tissue. One large, extremely thin-walled blood-vessel, apparently a dilated empty capillary, is usually conspicuous in the centre of each interspace. A comparatively thin, dense, sparsely nucleated, almost non-vascular fibrous layer usually terminates the new formation on its retinal aspect.

The newly-formed fibrous and osseous tissue thus constituted may form abrupt elevations on the inner choroidal surface, especially round the optic nerve entrance (*see* Case No. 762), or it may be more extended and attain an extreme thickness (*see* Plate, fig. 3), in which case there remains for the detached retina but a small cavity in the centre of the eyeball.

A delicate lamina vitrea can usually be traced as separating such formations from the comparatively thin and more pigmented choroid. The deepest layers of the new formation contain certain rounded* or elongated bodies, which, in their size and arrangement, remind us of the immediately adjacent layers or rods of bone (*see* Case No. 782, and Plate, fig. 3). But each is made of a more or less thick almost structureless wall enclosing a central yellowish granular substance. We lack evidence of the exact nature of these bodies. In many respects they resemble obstructed blood-vessels, whose walls are thickened and degenerated. Globes of similar yellowish

* Meyer, A. f. O., xxiii, 4, figures in a similar position certain rounded bodies which appear however to have the usual structure of so-called colloid bodies.

matter occupy in rare cases some of the interspaces of the bony network, and, more rarely still, similar globes, each enclosed in a hyaline ring, form projections on the retinal surface of the newly-formed bony and fibrous layer (*see* No. 730). Such may be either pedunculated or free lying. The latter condition may be explained by supposing that the section-knife has not passed through the peduncle.

In other cases, where the new formation takes the form of nodules on the retinal aspect of the lamina vitrea, these may be entirely or partially bony. Thus, we have a transition between the osseous formations and the so-called colloid bodies.

Sometimes these nodules are extremely large, even 1·5 mm. in height (*see* No. 566), and bands lying on the choroid may connect neighbouring ones.

Their structure is fibrous, fibro-cartilaginous, or osseous, the former predominating in their superficial layers, and the latter being more conspicuous towards their deeper part.

They have very commonly a central ill-defined cavity in which is yellowish granular matter, intermixed sometimes with colourless acicular crystals, the whole seeming to denote the previous existence of a vascular supply. Such bodies remind us in some degree of the yellowish granular spheres just described as existing within the new-formed osseous tissue or on its internal surface.

Other nodules, though still of fair size (·25 mm. in some instances), are more colloid like. For they are very commonly structureless in their superficial part, while their deeper part may contain well-developed bone corpuscles (*see* Plate, fig. 2), and do not contain any central cavity. They may rest directly on the unaltered lamina vitrea, or they may be separated from it by some nucleated fibrous tissue. In either case there may be a similar nucleated or bony tissue beneath the lamina vitrea.

It would appear that bone is never developed in the lamina supra-choroidea, or even in the tunica vasculosa of the choroid.

Besides the large bodies just described as existing on the inner choroidal surface, we have the smaller nodular elevations so long known as colloid deposits.

Some of them are distinctly composed of enlarged and but slightly pigmented cells of the pigment epithelial layer. One such degenerated cell may form a small projection, but more commonly a group of three or four forms a larger prominence. But the real colloid bodies are composed of a structureless basis substance between the lamina vitrea and its pigment epithelium, which may contain, especially in its deeper part, a few large oval feebly-staining nuclei, the whole having in this case somewhat the appearance of a so-called giant-cell; or the nodule may be calcified by the deposit of earthy salts in it.

It is extremely probable that these three conditions, the nucleated, the structureless, and the calcified, are successive stages. The overlying pigment epithelium presents in its appearance an associated variation. In one stage, probably the earliest or nucleated, its cells are enlarged and unduly black, so that the nodule, when viewed on the flat, is darker in colour than the surrounding choroid.

Or the pigment cells covering the centre may have vanished, leaving the colloid nodule set in a dark ring. When calcified, the nodules are entirely free from pigment cells, and constitute numerous small white pearly elevations. In connection with these changes, *see* Pagenstecher and Genth's admirable Atlas, Plate XVIII, fig. 1.

Such new formations, though they are said to be developed in senile eyes as a purely degenerative change, appear in the majority of cases to be the results of inflammation. Some of them, especially those which attain a considerable size, stain deeply with hæmatoxylin, and so uniformly that it is difficult to say whether corpuscular elements are present in them (*see* Nos. 248 and 63). In others the staining capacity is restricted to the central and deeper part.

These nodules have thus a position and origin different from the bony plates or nodules described as developed in the

midst of the hypertrophied pigment epithelium. Perhaps they are derived from that stratum of the lamina vitrea described as existing between the well-defined layer (to which we have in this paper restricted the term lamina vitrea) and the retinal pigment epithelium (Sattler, A. f. O. xxii, 2).

It will be gathered that we attach but little importance to the lamina vitrea as a source of these new formations. Indeed, in most cases it can be traced as a distinct layer, unaltered in structure, though much undulated. In rare cases, however, a thicker membrane, which appears to be continuous with the lamina vitrea, can be traced on to the pedicle of the detached retina in the immediate neighbourhood of the optic disc. It may also be studded with nodules which have every appearance of being thickenings of it. Perhaps examinations at an earlier stage may throw light on such apparently exceptional conditions.

The contributions of Wedl,* Iwanoff,† and Meyer‡ to the anatomy of colloid, are well known, as also the researches of Knapp§ and Goldzieher‖ on Osseous Formations (*see* also Becker's Atlas, Plates XXIII and XXIV).

Having discussed the nature and position of these new formations, a few words as to their etiology may not be out of place.

With regard to the first-described condition, the thickening of the lamina supra-choroidea, few cases have come under my observation. In one, the best marked, there was a clear history of necrosis of the cornea, the result of gonorrhœal ophthalmia. A condition somewhat similar in appearance is common as a result of the Choroiditis Maligna of sympathetic disease. The two, however, are for the most part clearly distinguished microscopically, for in the latter disease

* Atlas der path. Hist. Leipzig, 1860.
† Graefe and Saemisch, Handbook, vol. iv.
‡ A. f. O., vol. xxiii, 4.
§ A. f. O., vol. ii.
‖ A. f. O., vol. ix, 3.

the newly-formed tough, greyish, translucent fibrous tissue between Choroid and Sclerotic is much thicker and less dense. It is not at all improbable that the one may be the ultimate state of the other. If so, we must admit that choroiditis maligna, however typical its microscopical characters, does not always give rise to inflammations in the opposite eye.

In the cases above reported, I cannot fail to regard the colloid bodies on the Choroid as the results of inflammation. For there is in each of them a history of previous injury or disease, accompanied by pain and vascular injection.

I have no experience of the non-inflammatory senile colloid which has been described. It is rare, however, under any circumstances, to find exudation, which we can demonstrate to be inflammatory on the inner choroidal surface. On the contrary, exudations are conspicuously absent in Choroiditis Maligna, in Suppurative Hyalitis, or even in Suppurative Choroiditis, unless indeed the lamina vitrea chance to have been perforated. I am inclined to think, however, that they may be developed at a later stage of these choroidal inflammations, in which case they would be rather degenerative than acutely inflammatory. Their microscopic appearance does not indicate an acute stage of inflammation, for their nuclear elements are, as a rule, neither abundant nor deeply staining. In some cases, however, where old lost eyes have become suddenly painful, I have found deeply staining nodular elevations of considerable size on the lamina vitrea. But the microscopic characters of the accompanying choroidal inflammation were neither extensive nor of any well-marked type.

It is probable that the forms of inflammation which produce bone on the choroid are those which give rise to colloid deposits.

Inflammations accompanied by proliferation of the retinal pigment epithelium, are those which in many cases distinctly give rise to bone on the inner surface of the choroid. Wounds and perforating corneal ulcers are not infrequently followed by an inflammation possessing this character. In such cases

the general appearance of the fundus is very like that of Retinitis Pigmentosa. The Choroiditis sometimes met with in syphilis and also in myopia, may also present this character, and thus it comes that bone may be developed in consequence of these diseases. Such forms of Choroiditis are liable to be accompanied by a Cyclitis of a similar character. But the pigmented fibrous deposits on the inner surface of the ciliary body are rarely ossified. We find, however, an admirable example of localised ossification in No. 821. And as the choroidal changes may be diffuse or localised in spots, so we have spots or larger areas of fibrous and pigmented new formation on the inner surface of the ciliary body. Such localised areas are usually crescent-shaped, their long axis being parallel to the ciliary circle, and the subjacent ciliary body is atrophic, so that they project much less into the vitreous chamber than would be expected from their thickness (*see* No. 821).

Such forms of Cyclitis are, like the parallel form of Choroiditis, the results of injuries or of spontaneous inflammations which may possibly be connected with syphilis or myopia.

Calcifications within the lens capsule appear to be due to the same cause as osseous and colloid formations on the lamina vitrea, and the same may be said of the development of bone *in* the choroid.

ON THE MEANING OF THE WORDS "NYCTALOPIA" AND "HEMERALOPIA" AS DISCLOSED BY AN EXAMINATION OF THE DISEASES DESCRIBED UNDER THESE TERMS BY THE ANCIENT AND MODERN MEDICAL AUTHORS.

By John Tweedy, F.R.C.S.,

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Whatever view we may take of the nature of logic, whether, with Archbishop Whately, we regard it as entirely conversant about language; or, with Sir William Hamilton and Dean Mansel, as concerned with the acts and states of mind indicated by the words we use; or, with J. S. Mill, as dealing with the things concerning which we argue; or, lastly, with Mr. Stanley Jevons, as in a certain sense embracing all three, namely, language, thought, and objects;[1] we must admit that language is one of the principal instruments of thought, and that any imperfection in it, or in the mode of employing it, is liable to confuse and impede the process of thought, and to destroy all ground of confidence in the result.[2] Unless our language be at once accurate, precise, and unequivocal, it cannot be trusted as an instrument either of record or of communication.

In treating of the connexion between words and ideas, and of the fallacies, errors, and disputes arising from uncertain or mistaken significations of words, Locke says, "I am apt to imagine that, were the imperfections of language, as the instrument of knowledge, more thoroughly weighed, a great many controversies that make such a noise in the world would of themselves cease; and the way to knowledge, and perhaps peace too, lie a great deal opener than it does."[3] This is especially true of the language of science, where words are

[1] Jevons: "Elementary Lessons in Logic," 4th ed., p. 10.

[2] J. S. Mill: "A System of Logic," 7th ed., vol. i, p. 17.

[3] Locke: "An Essay concerning the Human Understanding," book iii, c. ix, sec. 21.

not only terms but definitions also. Hobbes defined *a name* as "a word taken at pleasure to serve for a mark, which may raise in our mind a thought like to some thought we had before, and which being pronounced to others, may be to them a sign of what thought the speaker had before in his mind."[1] The convenience and necessity of preserving the signification of words untainted is obvious. If I write the word "conjunctivitis," or "iritis," or "cataract," or "myopia," the reader at once forms a sufficiently intelligible idea of what I mean. So also with "mydriasis:" the mention of this word forthwith calls up the idea of a fixed dilated pupil, though here and there, perhaps, might be found one who, entrenching himself behind the sole authority of Aretæus,[2] would, pedantically, declare that the word called up in his mind the idea of "a pupil contracted to a small size." But what idea do I provoke when I employ the word "nyctalopia?" Nine persons out of ten, if they had the courage and confidence to avow it, would reply that they were not quite clear whether the term meant *night-blindness* or *night-sight:* though if pressed they would pronounce in favour of the latter. Nor would the answer seem unreasonable if we remembered that in all the best known published texts of Hippocrates, and in all the translations of this author, and in nearly every book written on Ophthalmology during the last century and a-half, the term "nyctalopia" is employed to denote the disease in which a person can see well by night and not by day. It is in this sense the word *νυκτάλωψ* is defined in the latest (6th) edition of Liddell and Scott's Greek-English Lexicon, on the one hand, and in the most recent and important treatise on modern Ophthalmology, on the other,[3] as well as in nearly every known scientific and medical lexicon, including that of

[1] "Computation or Logic," c. ii; cited by J. S. Mill, *op. cit.*, vol. i, p. 23; and by Jevons, *op. cit.*, p. 17.

[2] "De Sig. et Caus. Diut. Morb.," lib. i, c. vii; also "The Extant Works of Aretæus, the Cappadocian," trans. and edited by F. Adams, LL.D. Syden. Soc.: London, 1856; pp. 65 and 307.

[3] Graefe und Saemisch: "Handbuch der Gesammt. Augenheilkunde."

Blancard,[1] Kühn,[2] and the scholarly production of Littré and Robin.[3]

In spite of this remarkable consensus of opinion among modern authorities regarding the meaning of the word nyctalopia, it can be shown that according to the authority of the best classical writers, and according to the etymological construction of the word, the real meaning of the term nyctalopia is *night-blindness;* and consequently, that the meaning of the opposite term hemeralopia is *day-blindness*, and not *night-blindness*, as modern writers assert.

I have already mentioned the circumstances that led me to revive the discussion on the meaning of the words nyctalopia and hemeralopia.[4] The last number of these Reports contains a letter kindly and promptly written at my suggestion by Dr. W. A. Greenhill, the learned editor of Theophilus, of Celsus, and of Sydenham, and giving the results of a critical examination of the use of these words in the ancient Greek and Latin authors. The evidence adduced by Dr. Greenhill is conclusive. Henceforth, no one can defend the use of the word hemeralopia for *night*-blindness, and nyctalopia for *day*-blindness on philological or literary grounds. Dr. Greenhill has explained how the confusion arose. According to the ordinary texts of the Hippocratic writings, "nyctalopes" are said to be "those who see at night," whereas, for the reasons stated at p. 287, note 3, the original definition almost certainly was "those who do *not* see at night." This conjecture Dr. Greenhill defends with great ingenuity and learning. His position may, I believe, be further strengthened by comparing the clinical and pathological affinities of the nyctalopic affection described in the Hippocratic writings and the night-blindness of subsequent authors.

1 "The Physical Dictionary:" London, 1693.

2 "Lexicon Medicum:" Lipsiæ, 1832, vol. ii, pp. 10–18.

3 "Dictionnaire de Médicine:" 14th ed. Paris, 1878.

4 Prefatory Note to Dr. Greenhill's letter "On the meaning of the words 'Nyctalopia' and 'Hemeralopia,'" published in the last number of these Reports, p. 284.

It is this latter task I wish more particularly to attempt in this article.[1]

Many reasons might be assigned for believing the true meaning of the word nyctalopia to be night-*blindness*, and not night-*sight*. The principal ones are seven in number, and may be briefly expressed thus:—

1. All the ancient Greek medical writers, with the questionable exception of Hippocrates, and nearly all the Latin medical authors down to the end of the fourteenth century, as well as all other authors down to the middle of the seventeenth century, who define the term nyctalopia, use it in the sense of night-blindness.

2. As a *symptom* night-blindness is more frequent, more obtrusive, and more characteristic than night-sight. Indeed most, if not all, of the alleged cases of the latter are instances of dread of light,—photophobia, or heliophobia (Demours),—due to inflammation of some of the tunics of the eyeball, rather than of blindness by day and sight by night.

3. As an *amaurotic state or condition* night-blindness, whether it occur sporadically, or endemically, or epidemically, is comparatively frequent, and has been recognized in all ages, while the opposite condition of true night-sight is extremely rare, if not altogether unknown.

4. Even as regards the nyctalopic affections mentioned in the Hippocratic writings, there is almost conclusive evidence that they are essentially the same as those described by Aristotle and other writers as night-blindness. Most of the associated and predisposing conditions are the same, and many of the alleged concomitants are clearly those of night-blindness.

[1] It should perhaps be mentioned that this article was originally written to appear in conjunction with Dr. Greenhill's letter. It was, however, found on comparing them in print, that they travelled over much of the same ground, though for different purposes. It was, therefore, decided to publish Dr. Greenhill's letter first and independently, in order to keep the philological and the pathological arguments distinct and separate. In the interval I have taken the opportunity to revise and extend some portions of my article.

5. There is excellent manuscript authority that the writer of the second book of the Hippocratic treatise, named Prorrhetics, did actually state that persons who do *not* see at night are called nyctalopes.

6. If the term nyctalopia do not denote night-blindness, then we are compelled to conclude either that Hippocrates failed to recognize the affection; or, if he did recognize it, he did not deem it necessary to describe it or even to mention its special name.[1]

7. If the term nyctalopia originally meant night-*sight*, then we must conceive the philological absurdity of describing by a word having reference to night (*νύξ*), a pathological state or condition characterized by an inability to see during the *day*.

If these reasons be considered more closely, their force may perhaps become more apparent.

(1). The term nyctalopia is used to denote night blindness by every one of the best Greek medical writers from Aristotle to Joannes Actuarius. It is used in this sense also by Pliny in the first century; by Paré, Guillemeau, Schenk, and Forest in the sixteenth; and by Riolan, Ettmuller, and others in the seventeenth, century.

A glance at Table I will show that of all the authors whose writings are quoted, to the middle of the seventeenth century, only one, namely Hippocrates,[2] may be cited as using the term nyctalopia in the sense of *night-sight*. It is true that some confusion of meaning seems to have existed in the time of Aëtius[3]

[1] It should be remembered that the term *hemeralopia*, now used to denote night-blindness, was not known to the ancient authors; *see* Dr. Greenhill's letter, p. 284.

[2] "Prorrhet.," ii.

[3] Tetra. ii, serm. iii, c. xlvi. Though Aëtius describes nyctalopes as persons who see well by day and nothing at all by night, he also states that it happens to some (nyctalopes?) that they see *better* by night than by day, adding that this is rare. It may be that in the latter instance Aëtius is really referring not to nyctalopes but to hemeralopes, without using the term. The passage is, however, taken in the sense of nyctalopes, by the Paris editors of Stephanus' "Thesaurus;" by Foësius, in his edition of Hippocrates, sec. ii, p. 91 (Francof., 1595), and by Plempius, "Ophthalmographia."

in the fifth century, but Plempius,[1] in the seventeenth century, is one of the first writers who distinctly states that the term nyctalopia bears the double signification of night-sight (Hippocrates) and of night-blindness (Aëtius, Actuarius, and Paulus Aegineta). Plempius himself evidently inclines to the opinion that the former is the more correct, since he says, "Unde et Celsus non recte *Hippocratis* sententiam nocturnæ cæcitati accommodat."[2] Celsus,[3] it may be remarked, described night-blindness under the term "imbecillitas oculorum."

In the accompanying Table (I) only those authors are named who actually define the term nyctalopia or its cognates.

TABLE I.

NYCTALOPIA.

Night-Sight.	Night-Blindness.
Hippocrates (?)[4]	Aristotle.[5] Pliny.[6] Galen.[7] Oribasius.[8] Aëtius.[9] Alexander Trallianus.[10] Paulus Aegineta.[11] Joannes Actuarius.[12]

[1] "Ophthalmographia," 3rd ed.: Louvanii, 1659; lib. v, c. xxvi, p. 232*b*.

[2] *Op. cit.*, p. 234*a*.

[3] Lib. vi, c. vi., sec. 38.

[4] "Prorrhet.," ii.

[5] "De Generat. Animal.," lib. v, c. i.

[6] "Hist. Nat.," lib. viii, c. lxxvii; lib. xxviii, c. xlvii.

[7] "Obselat. voc. Hippoc. Explanat.," in Froben's Latin ed., Basil, 1561, vol. ix, p. 149; or Cratandar's Greek ed.: Basil, 1538, pars v, p. 714. *See also* Dr. Greenhill's letter, p. 285, note 4.

[8] "Synops.," viii, 46: "De loc. affect. curat. ad Eunap.," iv, 18.

[9] Tetra. ii, serm. iii. c. xlvi.

[10] "De Arte Medica," lib. ii, c. vi.

[11] "De Re Medica," lib. iii, c. xxii: "De Nyctalope."

[12] "Med. sive de Method. Medendi," lib. iv, c. xi; *ibid.*, lib. ii, c. vii, *νυκτάλωπας ἰαρινοὺς*.

NYCTALOPIA—*continued.*

Night-Sight.	Night-Blindness.
(16*th Century*).	(16*th Century*).
	Paré.[1]
	Guillemeau.[2]
	Forestus.[3]
	Schenkius.[4]
(17*th Century*).	(17*th Century*).
	Riolan.[5]
	Hoefer.[6]
	Ettmuller.[7]
Plempius.[8]	Plempius (?)[8]

It would therefore appear, that, with the possible exception of Hippocrates, and the unknown writer of the Galenic work, "Introductio, seu Medicus," no author of repute used the term nyctalopia to denote night-*sight* or day-*blindness*, before the seventeenth century. Even Plempius does not limit the term to night-sight; he rather speaks of two forms of nyctalopiasis, in one of which the patient cannot see well by night, in the other he cannot see well by day.

After the seventeenth century a very remarkable change occurs. The term nyctalopia loses the signification it has hitherto possessed, and gradually takes on that of night-sight, while the term hemeralopia is come into use to denote night-blindness. It is difficult to account for this change of meaning.

[1] "Œuvres Complètes d'Ambroise Paré," par J. F. Malgaigne: Paris, 1840, vol. ii, p. 415; liv. xv, c. v.

[2] "Traité des Maladies de l'Œil:" Paris, 1585, p. 27.

[3] "De Morbis Oculorum," 1591, or "Observat. et Curat. Medic.:" Francof, 1602, lib. xi, obs. xxxviii.

[4] "Observat. Med. Rar.," ed. by J. G. Schenkius: Francof., 1665, lib. i, p. 159.

[5] "A sure guide on the nearest and best way to Physick and Chyrurgery," trans. by N. Culpeper: Lond., 1671.

[6] "Hercules Medicus:" Noriberg, 1675, lib. i, c. viii.

[7] "Opera omnia:" Francof., 1688, "De Visus laesionibus," p. 475.

[8] "Ophthalmographia," 3rd ed.: Lovanii., 1659, p. 232.

The term hemeralopia (except in the "Introd. seu Med.") is seldom to be met with in medical writings before the eighteenth century, though it is evident from the descriptions given by Paré, and especially by Guillemeau, that the term was not unfamiliar in their time.

Paré (*circa* 1578) says: "*Acies nocturna:* quand on void mieux de nuit que de iour, et se peut dire *Hemeralopia* en grec, *Œil de chat* en françois;"[1] and Guillemeau, writing in 1585, speaks of "aveuglement de jour, dict en Grec *Ημεραλωπια.*"[2] Plempius, seventy-four years later, does not mention the term hemeralopia at all, though he discusses the problem "Cur nonnullorum oculi noctu sunt perspicaces, interdiu hebetiores?"[3]

With the eighteenth century, the term hemeralopia comes into frequent use, and almost invariably bears the meaning of night-blindness, instead of day-blindness as heretofore; while the meaning of the term nyctalopia, on the other hand, in its turn, is, as I have said, transferred from night-blindness to day-blindness. Mâitre-Jan as well as Bergen and Weise continue to employ nyctalopia as equivalent to night-blindness or day-sight, but Boerhaave, Guerin, and Sauvages use the word hemeralopia to denote this condition, while they apply the term nyctalopia to a confessedly rare condition of night-sight. The probable explanation of this extraordinary alteration, is that before the sixteenth century the works of Hippocrates were not accessible, and were consequently rarely consulted. Galen was the chief authority for the later Greeks and Romans, as well as for the Arabians; and though Hippocrates was held in high esteem by the ancient Greek and Latin physicians, he was not much studied during the Middle Ages. Galen had defined the Hippocratic term "nyctalopes" as those who are blind at night, and his definition was unquestioned till greater facilities occurred for

[1] *Loc. cit.*
[2] *Op. cit.*, p. 28.
[3] *Op. cit.*, lib. iv, prob. lviii, p. 177*b*.

consulting the Hippocratic treatises in the original.[1] In the sixteenth century Mercurialis (1588) and Foësius (1595) published their editions of the Hippocratic writings, and in the seventeenth century Vander Linden's edition appeared (1665). From this time more attention was given to the Hippocratic writings, and in the seventeenth and eighteenth centuries medical authors appealed to them in the original.

In all these editions the reading of the passage in the second book of the Prorrhetics is: "*Οἱ δὲ τῆς νυκτὸς ὁρῶντες, οὓς δὴ νυκτάλωπας καλέομεν. κ.τ.λ.*" "Those who see at night, whom we call nyctalopes, etc." Hence those who consulted the Hippocratic writings would naturally conclude that they had discovered an error in the commonly accepted meaning of the term nyctalopia, and that the term really meant night-sight, and not night-blindness, as Pliny, Galen, Aëtius, Paulus Aegineta, and others had supposed.

This reading is still generally accepted as authentic. Even Littré[2] did not think it necessary to alter it, though he mentions that its accuracy had been impugned by Coray.[3] In some other quarters, however, the reading has been blindly accepted without any suspicion of doubt or difficulty. The late Sir William Lawrence, for example, was not content merely to accept the common reading of the Hippocratic text, but in order to justify the use of the word hemeralopia to denote night-blindness, actually states, "Hippocrates uses the term hemeralopia to denote night-blindness, and we may as well follow his example,"[4] whereas Hippocrates does not use the term hemeralopia at all.

An examination of Table II will show how completely writers have turned about since the seventeenth century.

[1] See further on this question Dr. Greenhill's articles on Galen and Hippocrates in Smith's "Dict. of Greek and Roman Biography and Mythology," vol. ii, pp. 210 and 435.

[2] "Œuvres Complètes d'Hippocrate," tome ix, p. 65, note 9.

[3] Traité d'Hippocrate, "Des Airs, des Eaux, et des Lieux:" Paris, 1800; vol. ii, p. 45, *et seq.*

[4] "A Treatise on Diseases of the Eye," 3rd ed.: London, 1844, p. 584.

Table II.

NIGHT-BLINDNESS.

Nyctalopia.	Hemeralopia.
(18*th Century*).	(18*th Century*).
Maître-Jan.[1]	Boerhaave.[4]
Bergen and Weise.[2]	Guerin.[5]
	Sauvages.[6]
(19*th Century*).	(19*th Century*).
Grant[3]	De Wenzel.[7]
	Bampfield.[8]
	Demours.[9]
	Simpson.[10]
	Mason Good.[11]
	Scarpa.[12]
	De la Rue.[13]
	Wardrop.[14]

[1] "Traité des Maladies de l'Œil:" Troyes, 1707; p. 271.

[2] "De Nyctalopia seu Cæcitate Nocturna." Haller, "Disput. ad Morb.," p. 359; Franc., 1754.

[3] "Cyclop. of Pract. Med.;" edited by Forbes, Tweedie, and Conolly: London, 1834; Art. "Nyctalopia;" vol. iii, p. 183.

[4] "De Morbis Oculorum;" ed. Gotting: Gottingæ, 1750; p. 159.

[5] "Essai sur les Maladies des Yeux:" Lyon, 1769, p. 289.

[6] "Nosologia Methodica Oculorum." Selected and translated by George Wallis, M.D: London, 1785, p. 190.

[7] "Manuel de l'Oculiste:" Paris, 1808; vol. i, p. 345.

[8] "A Practical Essay on Hemeralopia, or Night-blindness," read Dec. 7th, 1812: "Med. Chir., Trans.": London, 1814; vol. v, p. 32, *et seq.*

[9] "Traité des Maladies des Yeux:" Paris, 1818; vol. i, p. 423.

[10] "Observations on Hemeralopia or Nocturnal Blindness:" Glasgow, 1819.

[11] "A Physiological System of Nosology:" London, 1820; p. lxix, and pp. 300–3. Also "The Study of Medicine," 3rd ed.: London, 1829, vol. iv, pp. 200–1.

[12] "Saggio di Osservazioni e d'esperienze sulle Principali Malattie degli Occhi:" Pavia, 1801, p. 251; or the French translation by MM. Fournier-Pescay et Bégin: Paris, 1821; vol. ii, p. 318; or the English translation by James Briggs, 2nd ed., p. 471: London, 1818.

[13] "Cours Complet des Maladies des Yeux;" 2nd ed.: Paris, 1823; p. 370.

[14] "The Morbid Anatomy of the Eye;" 2nd ed.: London, 1834; vol. ii, p. 205.

NIGHT BLINDNESS—*continued.*

Nyctalopia.	Hemeralopia.
(19*th Century*)—continued.	(19*th Century*)—continued.
Copland.[1]	Middlemore.[3]
Power.[2]	Tyrrell.[4]
	Hull.[5]
	Vidal (de Cassis).[6]
	Chelius.[7]
	Lawrence.[8]
	Desmarres.[9]
	Forbes.[10]
	Fabre.[11]
	Mayne.[12]
	Deval.[13]
	Costello.[14]
	Stellway von Carion.[15]
	Soelberg Wells.
	Seitz and Zehender.
	De Wecker.
	Galezowski.
	Tetzer.
	Schweigger.
	Macnamara.
	Lawson.[16]

[1] "A Dictionary of Practical Medicine:" London, 1844.

[2] "Diseases of the Eye:" London, 1868; p. 453.

[3] "A Treatise on the Diseases of the Eye, etc.:" London, 1835; vol. ii, p. 225.

[4] "A Practical Work on the Diseases of the Eye:" London, 1840; vol. ii, p. 283.

[5] "Cursory Notes on the Morbid Eye:" London, 1840; p. 210, *et seq.*

[6] "Traité de Pathologie externe," etc.: Paris, 1840; vol. iii, p. 188.

[7] "Handbuch der Augenheilkunde:" Stuttgart, 1843; vol. i, p. 358.

[8] "A Treatise on Diseases of the Eye;" 3rd ed.: London, 1844; p. 584.

[9] "Traité des Maladies des Yeux: Paris, 1847; p. 696.

[10] "Cyclop. of Practical Medicine;" vol. iv: "Select Medical Bibliography;" p. 124.

[11] "Bibliothèque du Médicin-Practicien:" Paris, 1849; vol. x, p. 100.

[12] "An Expository Lexicon:" London, 1860.

[13] "Traité de l'Amaurose:" Paris, 1851, p. 294.

[14] "Cyclop. of Practical Surgery:" London, 1861.

[15] It is not necessary to give detailed references to the writings of the following authors, as their works are well known and in general use.

[16] "Diseases and Injuries of the Eye;" 3rd ed.: London. In the fourth edition, 1880, Mr. Lawson, at my suggestion, substituted the term nyctalopia for hemeralopia, to denote night-blindness.

NIGHT-BLINDNESS—*continued.*

Nyctalopia.	Hemeralopia.
	(19*th Century*)—continued. Bader. Arlt. Hersing. *Et alii.*

Had the classification adopted in Table I been continued, it would have been found that nearly every author of the eighteenth and nineteenth centuries had been cited as using nyctalopia in the sense of night-*sight*. As no useful purpose would have been served by continuing such a classification, I have, in the second table, adopted another plan, namely, to arrange the authors of the eighteenth and nineteenth centuries according as they use the word nyctalopia or hemeralopia to denote night-blindness.

The general agreement among modern authors in using hemeralopia to denote night-blindness is startling, and might be held to be a sufficient reason for abstaining from any attempt to disturb the acquired *status quo* or to recover the original synonym. Even Dr. Copland, who uses the word nyctalopia in the sense of night-blindness, does so on inadequate and unsatisfactory grounds; and Mr. Power confessedly merely copies, without criticism or comment, the definition given in Copland's dictionary. Consequently, we are compelled to fall back upon Dr. Grant as one of the very few authors of the nineteenth century who deliberately use the term nyctalopia in the sense of night-blindness. Even he does not advance any specific justification of such a choice; and the advantage of his decision is minimised by the course taken by Dr. Forbes, the principal editor of the "Cyclopædia of Practical Medicine," in ignoring Dr. Grant's opinion, and adopting the opposite meaning in the Select Medical Bibliography appended to the fourth volume of this work.

The results of this examination and comparison of ancient and modern writers may, therefore, be thus summarized:

Up to the end of the fifteenth century writers are almost unanimous in using the word nyctalopia to denote night-blindness. The latter half of the seventeenth century is a period of transition. From the beginning of the eighteenth century onwards writers use the word hemeralopia in the sense of night-blindness, and nyctalopia for day-blindness.

(2). As a *symptom* night-blindness is more frequent, more obtrusive, and more characteristic than night-sight. Every ophthalmic surgeon is familiar with night-blindness as a symptom of some diseases of the retina and of the choroid, and, in a lesser degree, of certain anomalies of refraction and accommodation; but no such symptom as blindness by day with sight by night ever occurs. In some cases of keratitis, of iritis, and of choroiditis, there is more or less photophobia, so that vision is somewhat better when the eyes are shaded or when the light is dull. Most albinoes too see better in a dim light; and whenever there is a small central opacity of the cornea or crystalline lens, vision is better in a dull than in a bright light, because then the pupil dilates, and rays of light pass through the clear margin of the cornea or lens. This is one of the forms of *visus nocturnus* of Boerhaave,[1] which he regards as identical with the nyctalopia of Hippocrates. The true nature of this form of night-sight is easily recognized, and in the strict sense of the term there is neither blindness by day nor sight by night. A similar criticism may apply to some of the instances referred to by Pliny, Plater, Rhodiginus, Plempius, Briggs, Boyle, Willis, Schenkius, Porterfield, and others, of persons possessing the power of seeing and even reading in the dusk or dark. So far as these accounts are trustworthy, they merely show that some persons may possess or acquire a degree of visual power enabling them to distinguish objects in an imperfect illumination. In the year 1867, Dr. Arlt,[2] of Vienna, described

[1] *Op. cit.*, pp. 137 and 162: Probably the high authority of Boerhaave was the chief factor in establishing the change of meaning of nyctalopia.

[2] "Der Bericht ueber die Augenklinik," 1867. See also American translation by Dr. Weightman: Philadelphia, 1868.

a form of retinitis which he designated *Retinitis nyktalopica*, in which, during the day, all objects appear to be covered by a silvery fog or haze, which is not noticeable at dusk. This form of retinitis does not, however, materially affect the present question.

(3). It is scarcely necessary to bring forward any special testimony as to the occurrence of night-blindness as an amaurotic affection. It is known to occur sporadically, or as an epidemic, or to prevail endemically in certain localities. The opposite condition of night-sight is probably unknown as an amaurotic condition.

It is a matter of common knowledge that night-blindness as an amaurotic affection is still prevalent in certain localities. On the other hand, it is doubtful whether any amaurotic condition is known in which the eyes are blind during the day, but possess the power of seeing at twilight or in the dark. Ramazzini[1] has alleged, that about the spring of the year he frequently met with young persons who were unable to see during the day, but who could see when night came on again. In about a month they recovered. These observations have not, however, been confirmed by other competent observers. Demours,[2] Middlemore,[3] Tyrrell,[4] Lawrence,[5] Mackenzie,[6] and most other authors, either deny the existence of such a disease, or assert it to be of extremely rare occurrence. The cases quoted by Mettrie,[7] Lassus,[8] Hillary,[9] Pye,[10] M. Guthrie,[11]

[1] "De Morbis Artificum," c. xxxviii; "Opera," p. 363: London, 1718.

[2] *Op. cit.*, vol. i, p. 432.

[3] *Op. cit.*, vol. ii, p. 233.

[4] *Op. cit.*, vol. ii, p. 283.

[5] *Op. cit.*, p. 589.

[6] "A Practical Treatise on Diseases of the Eye;" 4th ed.: London, 1854; p. 996.

[7] "Institutions de Médecine de Boerhaave, avec un Commentaire;" 2nd ed.: Paris, 1747; tome iv, pp. 431, 432.

[8] "Pathologie Chirurgicale," 1805–6; tome ii, p. 539, *et seq.*

[9] Quoted in Cooper's "Dictionary of Practical Surgery," Art. "Nyctalopia," vol. ii, p. 364.

[10] *Ibid.*

[11] "Duncan's Med. Commentaries;" vol. xix, p. 290: Edinburgh, 1795.

Larrey,[1] Isbell,[2] and others will not enable us to form a category of diseases characterised by night-sight or day-blindness, in the same manner as we may form a category of diseases characterised by night-blindness. The predominating symptom in most, if not all the cases mentioned is, as I have already stated, dread of light, or photophobia. I have often seen persons engaged in out-door occupations who were thought to be suffering from day-blindness. They could see fairly well in the twilight, but were unable to get about during the day in bright sun-light. In every instance I found either a small vascular ulcer or other affection of the cornea, or some form of chronic conjunctivitis. The symptom was, therefore, photophobia, due to inflammation, and not amaurotic.

(4). A comparison of the meagre accounts given in Hippocrates of the condition of the persons designated "nyctalopes," and the fuller descriptions of night-blindness by later authors will, I believe, lead inevitably to the conclusion that the nyctalopes of Hippocrates are the same as the night-blind individuals of later authors; and, hence, that Hippocrates, or the writer of the second book of the Prorrhetics, intended to say that persons *not* seeing at night are called nyctalopes. This comparison of Hippocrates with the later authors applies not only to the definition of nyctalopia, but also to the description of the disease, to its course, its etiology, and its treatment.[3]

The predisposing and indisposing conditions, the concomitants, and other peculiarities of Hippocrates' nyctalopia, may be briefly enumerated as follows:—

(a) It chiefly occurs in children, and young adults.[4]

[1] "Mémoires de Chirurgie Militaire;" tome i, p. 6: 1812.

[2] "Edinburgh Med. and Surg. Journal;" vol. ix, p. 269: Edinburgh, 1813.

[3] It should be borne in mind that though Hippocrates is usually spoken of as the author of the works cited in this article, the best critics do not, for other reasons, believe that any of the treatises containing references to nyctalopia were really written by him.

[4] "Epid.," vi, sec. 7; "Prorrhet.," ii.

(*b*) Dark eyes, and eyes with small pupils are predisposed to it.[1]

(*c*) Married women and virgins whose menses are regular are not subject to it.[2]

(*d*) Eruptions appear about the ears on the seventh or eight day.[3]

(*e*) The formation of abscesses, and spontaneous diarrhœa are favourable prognostics.[4]

(*f*) The treatment consists of bleeding, purging, cupping, and the injection of ox's liver steeped in honey.[5]

(*g*) The disease is sometimes complicated by swelling of the gums, toothache, foul breath, swelling below the eyes, bleeding from the nose, ulcers on the legs, and enlarged spleen.[6]

All these circumstances and peculiarities are, separately or combinedly, mentioned by other authors as pertaining to night-blindness.[7]

Age.—It is commonly assumed that Hippocratic nyctalopia is a disease of childhood. M. Sichel, in the introduction to his translation of the treatise *Περὶ ὄψιος*, published in Littré's edition of Hippocrates,[8] contends that the disease designated nyctalopia, and described in the second book of the Prorrhetics, corresponds exactly with the scrofulous and some of the epidemic ophthalmiæ of children. This assumption is not justified by the text, *νέοι, ἢ παῖδες ἢ νεανίσκοι.* The term *νέοι* applies not only to children, but to *men at least as old as thirty*,[9] and the term *νεανίσκοι* certainly

[1] "Epid.," vi, sec. 7.

[2] "Prorrhet.," ii.

[3] "Epid.," iv.
"Prorrhet.," ii.

[5] "De Visu."

[6] "Prorrhet.," ii.

[7] It is not now the question whether these allusions are true or not. They are merely cited as illustrating the opinions of the various authors respecting night-blindness, and as showing that they ascribed to night-blindness the same qualities as those said to belong to nyctalopia.

[8] Tome ix, p. 122, *et seq.*

[9] *See* Liddell and Scott's Greek Lexicon, *νέος* and *νεανίσκος*.

includes men old enough to engage in battle, and to marry.[1]

The disease may, therefore, be said to occur not only in children (παῖδες), but also in young adults up to the age of forty. Moreover, the statement, presently to be discussed, that married women are not subject to the complaint, also implies that the disease is not exclusively one of childhood.

Colour of the eyes, etc.—Dark eyes and eyes with small pupils are said to be especially predisposed to Hippocratic nyctalopia.[2] Aristotle and other authors state these eyes show a similar predisposition to *night-blindness*.

In treating of some of the causes of the difference in colour of the eyes of different individuals, Aristotle remarks that it had been assumed, on insufficient grounds, that pale blue eyes (γλαυκόμματα) have more of fire, as Empedocles had said, and dark eyes (μελανόμματα) more of water than of fire; adding that it had been incorrectly stated that lack of moisture is the reason why blue eyes cannot see well by day, as want of fire is the reason why black eyes cannot see well by night.[3] In opposition to this view Aristotle asserts, with Democritus, that in every case vision is of water, and not of fire.[4] The eye is made of water, because this is transparent; and the amount of fluid (τὸ ὑγρόν) in the eye determines the colour of the eye. Eyes that have much moisture are dark, and those that have little are blue. This is the reason why blue eyes cannot see well by day, or black eyes by night; because blue eyes, on account of the scarcity of their moisture, are too much agitated by the light, whereas black eyes, from an excess of moisture, are not so easily set in motion.[5] Moreover, nocturnal light is very feeble, and does

[1] Herodt. iv, 72, 112, 114 and 115.

[2] "Epid.," vi, sec. vii, 1.

[3] "De Generat. Animal.," lib. v, c. i.

[4] *Ibid.*; and "De Sensu," c. ii.

[5] Aristotle's theory of vision was that visible objects set in motion a transparent medium between them and the eye, and that this motion is, in its turn, communicated to the sense-organ. "De Anima.," lib. ii, c. vii; "De Sensu," c. ii and iii; "De Generat. Animal.," lib. v, c. i.

not excite sufficiently the copious fluids of the dark eyes. Corresponding differences are, he continues, to be observed in the kind of diseases that affect blue eyes and dark eyes respectively. Cataract (*γλαυκωμα*) occurs in blue eyes, and "nyctalopia" in dark eyes. Cataract being a dryness of eyes, chiefly affects old people, but nyctalopia being due to a superabundance of moisture occurs in those who are younger (*τοῖς νεωτέροις*).[1] Similarly, Levinus Lemnius, though he does not use the term nyctalopia, says that dark eyes may be of such condition that they see acutely during the day, but badly and less clearly at night. (Noctu vero obtuse minusque acute videndi munere funguntur.)[2]

The size of the pupils.—Both Plempius[3] and Boerhaave[4] describe the connexion between night-blindness and narrowing of the pupil. Indeed, both these writers ascribe night-blindness to contraction and non-dilatability of the pupil rather than to thickening and opacity of the tunics and humours of the eye, as Aëtius had supposed;[5] "Quia in nyctalopia seu cæcitudine nocturna vesperi ægri non vident, sic tamen, ut die sat recte cernant; at qui crassas tunicas humoresque sortiti sunt, ne quidem die res probe intuentur."[6] According to Boerhaave the power of seeing at night is determined by the degree of dilatability of the pupil, and the reason why horses see better than men in the dark, is that horses have larger pupils, and hence more light can enter their eyes, but if the pupil do not dilate then they cannot see at night.[7]

The Immunity of Women.—Hippocrates states that married women and virgins who have the menstrual discharge

[1] Not necessarily young children, but *men of military age.* Thucyd., v, 50. *See* Liddell and Scott. *νεώτερος.*

[2] "De Miraculis Occult. Naturæ." Francof., 1604; lib. iv, c. vi, p. 375.

[3] *Op. cit.*, p. 233.

[4] *Op cit.*, p. 160.

[5] Tetr., ii; serm. iii, c. xlvi.

[6] Plempius, *loc. cit.*

[7] *Op. cit.*, p. 165.

regular are not subject to nyctalopia.[1] Celsus long after claimed for them a similar freedom from *night-blindness*:—"Præter hæc, imbecillitas oculorum est, ex qua quidam interdiu satis, noctu nihil cernunt; quod in fœminam bene respondentibus menstruis non cadit."[2] It will, I imagine, scarcely be contended that Celsus and the writer of the Hippocratic treatise are speaking of exactly opposite diseases, night-*blindness* and night-*sight* respectively. Exemptions so peculiar can only apply to similar diseases. The freedom from night-blindness of women in whom the catamenia are regular is mentioned by many other ancient Greek and Latin authors, though this alleged immunity has not been confirmed by modern authors, except that women are less exposed to the conditions which tend to induce night-blindness. In an epidemic of night-blindness which occurred in the district of Mausanne, it was noted by Fleury and Frechier[3] that *pregnant* women were most affected with it, though no age or sex was spared.[4]

The appearance of eruptions about the ears,[5] and *the supervention of abscesses and diarrhœa*,[6] are regarded as favourable prognostics in the Hippocratic nyctalopia. Though Bampfield, to whom we are indebted for the most trustworthy modern account of night-blindness, states that he could not perceive "that any particular constitutions or ages, or eyes of any particular description, form, or colour," were particularly subject to night-blindness;[7] he did find "a

[1] Prædict. ii, 40; Vander Linden, vol. i, p. 517; or, Prorrhet. ii, 33, 34, in Littré, t. ix, p. 64; or Prædict. II, in Foësius, sec. ii, p. 91. See also Adams's translation of "The Genuine Works of Hippocrates;" Syden. Soc.: London, 1849; vol i, p. 267.

[2] "De Medicina," lib. vi, c. vi.

[3] Quoted from the "Bulletin de Therapeutique," in Johnson's "Medico-Chirurgical Review," July 1842, p. 193; and cited by Mackenzie, *op. cit.*, p. 993.

[4] See also Dr. Grant's article, "Nyctalopia," in "Cyclop. of Prat. Med.," vol. iii, pp. 184, 185.

[5] "Epid.," iv.

[6] Prorrhet., ii.

[7] *Op. cit.*, p. 41.

spontaneous cure has sometimes succeeded to the eruption of boils on the face or head, and to the formation of abscesses of the face, head, or ears."[1] He also asserts that in cases of night-blindness associated with scurvy, "after a fresh animal and vegetable food has been instituted and persevered in for a short time, and the scorbutic diathesis is corrected, if a lax state of the bowels is not induced by the change of diet, as is usually the case, I have frequently directed cathartics;" adding that, though he had never administered cathartics without employing local treatment, he had, in several cases, observed so prompt a recovery from the combination, "that I have been induced to ascribe much of the benefit obtained to their use."[2]

The Treatment.—Perhaps the strongest argument that can be advanced in support of the opinion that the nyctalopia of Hippocrates, and that of the later Greek and Latin authors are the same, is the remarkable similarity in the reputed remedies. This is especially noticeable with regard to the local application of the bile or the sanies of liver, and to the ingestion of raw or roasted liver. The writer of the Hippocratic treatise "De Visu" recommends an ox's liver, but other writers seem to prefer that of the goat or the sheep. Galen, Celsus, and Pliny also mention and recommend this mode of treatment; indeed Pliny enters upon a long and detailed explanation of the *modus operandi* of goat's liver in curing persons who cannot see by night (*nyctalopas* a Græcis dictos).[3] Goat's or sheep's liver, or the liver of some other animal, is also recommended by Oribasius,[4] Marcellus,[5] Aëtius,[6] Alexander Trallianus,[7] Paulus Aegineta,[8] and Actuarius.[9]

[1] *Op. cit.*, p. 49.

[2] *Op. cit.*, p. 51.

[3] "Hist. Nat.," lib. xxviii, c. 47. *See*, further, Dr. Greenhill's letter, p. 285, notes 4 and 5.

[4] "De loc. Affect. cur.;" lib. iv, c. 18.

[5] "De Medicamentis," cap. viii.

[6] Tetr. ii, serm. iii, c. xlvi.

[7] "De Arte Med.," lib. ii, c. vi.

[8] Lib. iii, c. xxii.

[9] "Med. sive Meth. Med.," lib. iv, c. xi.

Guillemeau[1] refers to it, and Scarpa,[2] citing Dupont,[3] also mentions it. Adams, in his commentary on Paulus Aegineta,[4] states that Rhases, Avicennna, Mesue, Jesu Haly, Haly Abbas, and Alsaharavius also speak favourably of the application of the roasted liver in cases of night-blindness.

Even in recent times the hepatic treatment of night-blindness has been employed. Dr. Grant[5] quotes the experience of Dr. Meissener, and states that he himself "has repeatedly seen a cure *apparently* produced by fumigating the eyes with the vapour of a bullock's liver," though he does not believe that there is any specific virtue in the liver.

The concomitants of Hippocratic nyctalopia are swelling of the gums, toothache, foul breath, swellings below the eyes, bleeding from the nose, enlarged spleen, and ulcers on the legs.[6] I need scarcely say that this train of symptoms indicates the condition now called Scorbutus, of which night-*blindness* is a well-known symptom. The account given by Hippocrates may not be a perfectly accurate description of scorbutus in all its parts, but it is sufficiently correct to enable us to identify it. Van Swieten pertinently remarks: "Although it cannot be denied but the ancient physicians have reckoned up many of the symptoms of the scurvy in their descriptions of several distempers, handed down to us under a different denomination; yet it is not so apparent that they have seen into the real nature of the distemper itself, nor so plainly described the symptoms of it, that one may be able from them to gather a full knowledge of the scurvy."[7] Of the accounts given in the Hippocratic writings, he remarks, "though he [Hippocrates] mentions a great many symptoms of the scurvy, seems not to have judged that

[1] *Op. cit.*, pp. 27, 28.

[2] *Op. cit.*, p. 254; and vol. ii, p. 323, of the French translation.

[3] "Mémoire sur la goutte sereine nocturne épidémique, ou Nyctalopie."

[4] Book iii, sec. 22; Syd. Soc. ed.; vol. i, p. 434.

[5] *Op. cit.*

[6] "Prorrhet.," ii.

[7] "Comment in Hermanni Boerhaave Aphorism:" Lug. Bat., 1753, t. iii, p. 590; or Eng. trans.: Lond., 1754, vol. xi, p. 278.

they all concurred together to make up one particular distemper, but supposed them to come from some defects in spleen."[1]

It would lead me too far to trace out all the points of resemblance, nor is it necessary for the purpose of this article that I should do so. I would, however, call attention to the fact that all modern observers are agreed that night-blindness is a frequent concomitant of scorbutus. Wolfgang Hoefer states that in the time of the Swiss war he had seen many soldiers and others suffering from night-blindness, due to the scarcity of provisions. These were all cured by an improved diet (curantur verò tales mutatione diætæ in meliorem).[2] Sir Gilbert Blane states that night-blindness, as a symptom of scurvy, had been reported to him by Mr. Telford,[3] and Dr. W. Kerr alleges that it was a common occurrence among the scorbutic patients in the garrison of Gibraltar, during the siege of that place.[4] Andrew Simpson also mentions the frequent co-existence of night-blindness and scurvy.[5] The association has, however, in recent times been especially insisted on by Bampfield,[6] and has been confirmed by others. In some cases of scurvy occurring in H.M. brigantine "Griffon," and recorded by Dr. Bryson, night-blindness was the first symptom of the disease.[7]

The frequent association of scorbutus and night-blindness will not be disputed, and I have little hesitation in expressing the opinion that the many of the "nyctalopes" of Hippocrates were actually suffering from scurvy. If this opinion be well-founded, it lends powerful and independent support to the amended reading of *οὐχ ὁρῶντες*, in "Prorrhet.," ii, inasmuch as night-*sight* has never yet been observed as a concomitant of scorbutus, whereas night-*blindness* is often present.

[1] *Op. cit.*, t. iii, p. 591; or Eng. trans., xi, p. 281.

[2] "Hercules Medicus:" Noriberg, 1675; lib. i, c. viii, p. 72.

[3] "Observations on the Diseases of Seamen," 3rd ed.: Lond., 1799.

[4] Art. "Scorbutus," in Cyclop. of Pract. Med.: Lond., 1834; vol. iii, p. 684.

[5] *Op. cit.*

[6] *Op. cit.*, p. 33, *et seq.*

[7] "Ophth. Hosp. Rep.," vol. ii, p. 40; July, 1859.

This hypothesis likewise furnishes a clue to the *rationale* of the alleged cure of nyctalopia by means of bullock's or goat's liver, as related above. The fresh roasted liver, whether of a bullock, goat, sheep, black-cock, or other animal would act beneficially on the scorbutic condition of the body, and would in this way expedite the cure of the disordered vision. It is worthy of note, too, that many of the other remedies recommended in the Hippocratic collection for the cure of nyctalopia are also serviceable in scurvy, and that the favourable prognostic signs are also those of scorbutus.

(5). For the fuller consideration of the fifth reason, namely, that there is good manuscript authority for the belief that the reading in the second book of the Prorrhetics should be that persons who do *not* see at night are called nyctalopes, I must, beyond what I have already incidentally remarked, refer the reader to Dr. Greenhill's letter and criticism, and especially to the valuable note on page 287. I may, however, observe that an omission of *οὐ* or *οὐκ* from ancient manuscripts is by no means rare. Such an omission occurs in the Hippocratic treatise *De Internis Affectionibus,* where persons who have ulcers on the legs with the skin black and thin, are said to be eager to walk about and to make exertion.[1] This should obviously be read, "are *not* disposed to walk about or to make exertion," and is so read by Littré[2] and Vander Linden,[3] both of whom supply the *οὐ*. The omission of the word *οὐ* is, in this instance, as in the second book of the Prorrhetics, obviously a fault of the copyist. The text in the latter instance, as Chamseru, Coray, Ermerins, and Dr. Greenhill believe, should be *οἱ δὲ τῆς νυκτὸς ΟΥ̓Χ ὁρῶντες. κ.τ.λ.* Coray remarks[4] that the inad-

[1] Foësius, "Hippoc.," sec. v, p. 119; Linden, ii, 256.

[2] *Op. cit.*, t. vii, p. 280.

[3] *Op. cit.*, vol. ii, p. 256. It is an odd circumstance that while Vander Linden inserted *οὐ* in the Greek text of his edition of Hippocrates, he did not correct the Latin translation, which is, "Est autem ad deambulandum ac laborandum promptus."

[4] "Traité d'Hippocrate des Airs, des Eaux, et des Lieux:" Paris, 1800; vol. ii, p. 45.

vertent omission of *οὐ* is especially common after words ending in *ος*, as in this instance (*νυκτὸς*), or in the treatise "De Aëribus, Aquis, Locis," where he has inserted *οὐ* between *πλῆθος* and *γλυκαίνεται*.[1]

The adoption of the reading *οὐχ ὁρῶντες* would not only get rid of the otherwise inexplicable confusion, but would furnish a meaning of the term nyctalopia more in accordance with the principles of etymology than *night-sight* supplies. Indeed, unless we are prepared to accept Voltaire's satirical definition of etymology, as "une science où les voyelles ne font rien, et les consonnes fort peu de chose," we must, independently of any other testimony, recognize the negative or privative element in the words "nyctalopia" and "hemeralopia." To employ the word nyctalopia as night-sight, and hemeralopia as night-blindness, seems, as I have already stated (p. 417), a philological extravagance and absurdity.[2]

The contention that true *night-blindness* was not known in the time of Hippocrates, has been already met by anticipation in the comments on Aristotle's explanation of the differences of colour in the eyes, and of the causes of night-blindness in persons who have *dark* eyes. (*See* p. 429.)

On these grounds we must, I think, agree with Galen, that the true meaning of nyctalopia is night-blindness (*ὁ τῆς νυκτὸς ἀλαός*), and, consequently, that the true meaning of hemeralopia is day-blindness.

Unless, therefore, we are disposed to adopt the suggestion of the late Dr. Mackenzie, not to use these terms at all, in any sense, we should retrace our steps, and abandon the later (false) meanings for the original and true ones.

[1] "Traité d'Hippocrate des Airs, des Eaux, et des Lieux:" Paris, 1800; vol. i, p. 14. Littré (t. ii, p. 18) gets over the difficulty by substituting the word *ἐγγίγεται* for *γλυκαίνεται*; while Adams, in his translation (vol. i, p. 193), omits the clause altogether.

[2] See further, Dr. Greenhill's critical remarks, p. 288, *et seq.*

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